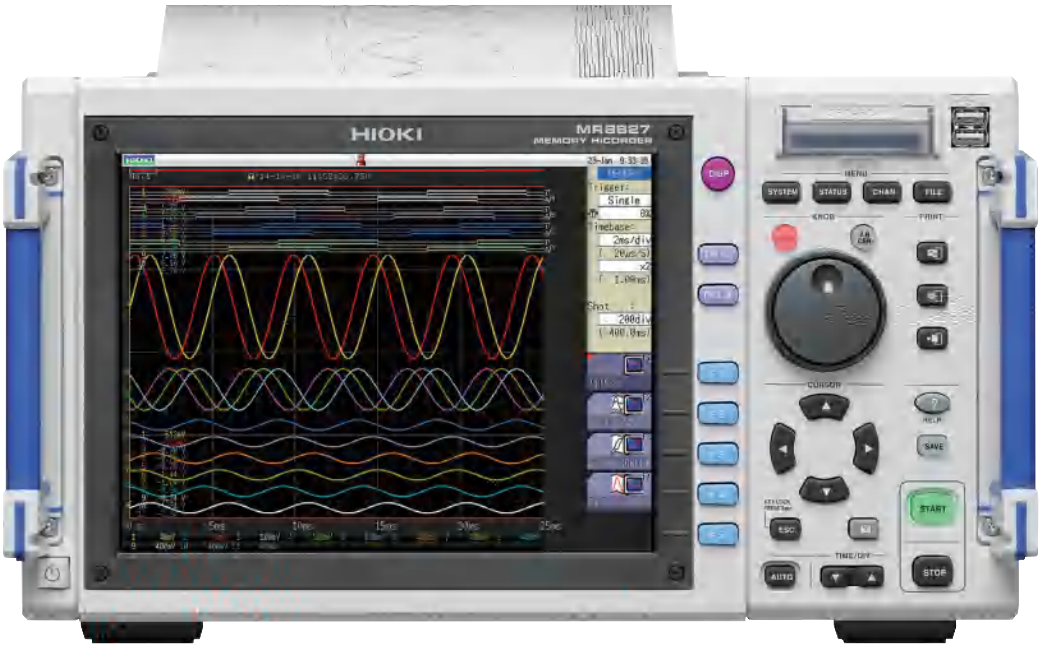
HIOKI

MR8827

Instruction Manual

MEMORY HiCORDER



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Introduction

Thank you for purchasing the HIOKI MR8827 Memory HiCorder. To obtain optimal performance from this instrument, please read this manual and keep it handy for future reference.

The optional clamps (p. A9) are called by a generic name of “clamp sensor.”

The following instruction manuals are available for this instrument. Refer to the relevant manual as usage.

Type	Contents	Printed	CD-stored
Instruction Manual (This document)	Contains details and specifications regarding the functions and operations of this instrument.	✓	–
Communication Command Instruction Manual	Contains a list of the communication commands and their explanations to control the instrument with a computer.	–	✓
U8793, MR8790, MR8791 Instruction Manual	Contains specifications and explanations of functions/ operations of Models U8793 Arbitrary Waveform Generator Unit, MR8790 Waveform Generator Unit, MR8791 Pulse Generator Unit, and SF8000 Waveform Maker.	–	✓

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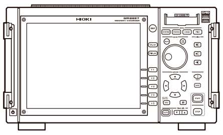
Package Contents

When you receive your Memory HiCorder, inspect it carefully to ensure that no damage occurred during shipping. Please pay particular attention when checking the accessories, panel keys and switches, and connectors. If you find damage, or your HiCorder fails to operate according to specifications, contact your authorized Hioki distributor or reseller.

Keep the packing material used for the shipping of the instrument because you need to use it when transporting the instrument in the future.

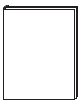
Unit and Accessories

Confirm that you received the following items: (One each)

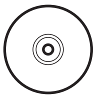


☐ MR8827 Memory HiCorder

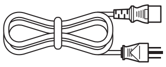
Accessories



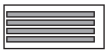
☐ Instruction Manual



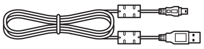
☐ Application disc (CD)[*2]
(p. 335)
- SF8000 Waveform Maker
- Wave Viewer (WV)
- Communication Command Instruction Manual
- U8793, MR8790, MR8791 Instruction Manual



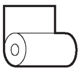
☐ Power cord



☐ Input cable labels

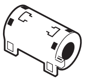


☐ USB cable



☐ 9231 Recording Paper
(When Model U8350 Printer Unit is installed)

☐ Paper Roll Axle
(When Model U8350 Printer Unit is installed)



☐ Ferrite clamp-on choke[*1]
(For LAN/USB Cable)

Other options as specified in your order
Refer to “Appendix 3.1 Options” (p. A9).

*1: If one or more Model 8967 Temp Units are installed in the instrument, two ferrite clamp-on chokes (small) will be supplied per module.

*2:The latest version can be downloaded from our website.

Safety Information

This instrument and modules are designed to conform to IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, using the instrument in a way not described in this manual may negate the provided safety features.
Before using this instrument, read and understand the following safety notes.

⚠DANGER

❗ **Mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use.**

⚠WARNING

❗ **Electricity presents risks of electric shock, heat generation, fire, and arc discharge due to short circuits. If anyone who is unfamiliar with electrical measuring instruments will use the instrument, a person familiar with such instruments must supervise operations.**

Protective gear

⚠WARNING

❗ **This instrument is measured on a live line. To prevent electric shock, use appropriate protective insulation and adhere to applicable laws and regulations.**

Notation

In this manual, the seriousness of risks and hazard levels are classified as follows.

⚠ **DANGER**	Indicates an imminently hazardous situation that will result in death or serious injury to the operator.
⚠ **WARNING**	Indicates a potentially hazardous situation that may result in death or serious injury to the operator.
⚠ **CAUTION**	Indicates a potentially hazardous situation that may result in minor or moderate injury to the operator or damage to or malfunction of the instrument.
IMPORTANT	Indicates information related to the operation of the instrument or maintenance tasks with which the operators must be fully familiar.
⚡	Indicates a high voltage hazard. If a particular safety check is not performed or the instrument is mishandled, this may give rise to a hazardous situation; the operator may receive an electric shock, be burned or even be fatally injured.
🚫	Indicates prohibited actions.
❗	Indicates actions which must be performed.
*	Additional information is presented below.

Symbols Affixed to the Instrument

⚠	Indicates cautions and hazards. When this symbol is printed on the instrument, refer to the corresponding topic in this Instruction Manual.
⏻	Indicates the ON or OFF side of the power switch.
⏚	Indicates a grounding terminal.
⎓	Indicates DC (Direct Current).
∼	Indicates AC (Alternating Current).
⚠	Indicates a burn hazard if touched directly.

Standards Symbols

	This symbol indicates that the electrical and electronic appliance was put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).
CE	This symbol indicates that the product conforms to regulations set out by the EU Directive.

Other Symbols

This manual uses the following symbols to indicate specific information for operating the instrument.

(p.)	Indicates the location of reference information.
CURSOR (Bold text)	Names of settings, buttons, and other screen elements are written in bold blue text.
	Unless otherwise specified, “Windows” refers to Windows 7, Windows 8, or Windows 10.
[ ]	Menus, commands, dialogs, buttons in a dialog, and other items on the screen and keys are enclosed in brackets.
MEM	Indicates Memory function support.
REC	Indicates Recorder function support.
X−Y	Indicates X-Y Recorder function support.
FFT	Indicates FFT Recorder function support.
	Click: Press and quickly release the left button of the mouse. Right click: Press and quickly release the right button of the mouse. Double click: Quickly click the left button of the mouse twice.

Accuracy

We define measurement tolerances in terms of f.s. (full scale), rdg. (reading) and setting values, with the following meanings:

f.s. (maximum display value or scale length)	The maximum displayable value or scale length. For this instrument, the maximum displayable value is the range (V/div) times the number of divisions (20) on the vertical axis. Example: When range is 1 V/div, f.s. = 20 V
rdg. (display value)	The value currently being measured and indicated on the measuring instrument.
setting	Indicates the value set as the output voltage, current, or other quantity.

Measurement Categories

To ensure safe operation of measuring instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, called measurement categories.

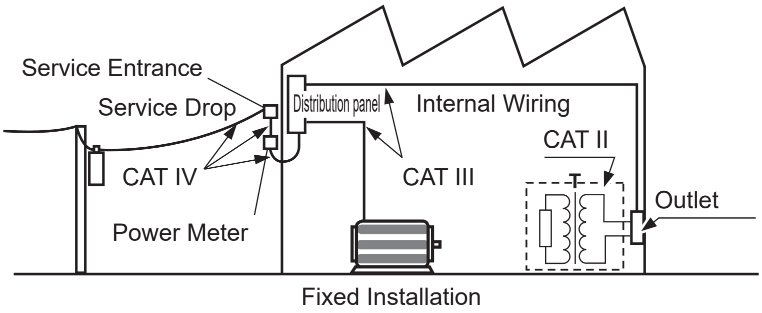
⚠DANGER

- **Using a measuring instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in severe accidents, and must be carefully avoided.**
- **Using a measuring instrument that has no category rating in an environment designated with the CAT II to CAT IV category could result in severe accidents, and must be carefully avoided.**

CAT II: When directly measuring the electrical outlet receptacles of the primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)

CAT III: When measuring the primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets

CAT IV: When measuring the circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



The applicable measurement category is determined by the module being used.
Refer to “18.6 Module Specifications” (p. 368).

Operation Precautions

Before Use

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.
Ensure that your use of the product falls within the specifications not only of the instrument itself, but also of any accessories, options and other equipment being used.

⚠DANGER

If connection cables or instrument are damaged, there is a risk of electric shock. Before using the instrument, perform the following inspection.

- **Before using the instrument, check that the insulation of the connection cables is not damaged and that no metal parts are exposed. Using the instrument under such conditions could result in electric shock. Replace the connection cable with those specified by our company.**
- **Verify that the instrument operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.**

Installing the instrument and modules

⚠WARNING

To avoid accidents or damage to the instrument, do not install the instrument and modules in locations that are:

- **Exposed to direct sunlight or high temperature**
- **Exposed to corrosive or combustible gases**
- **Exposed to a strong electromagnetic field or electrostatic charge**
- **Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)**
- **Susceptible to vibration**
- **Exposed to water, oil, chemicals, or solvents**
- **Exposed to high humidity or condensation**
- **Exposed to high quantities of dust particles**

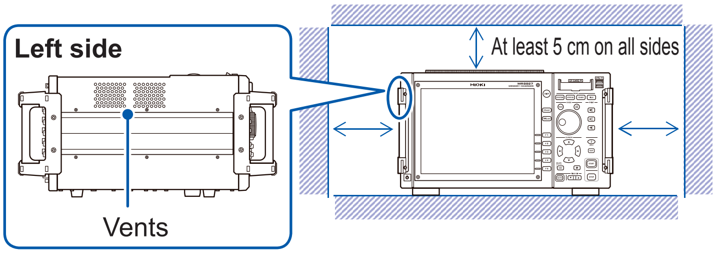
⚠CAUTION

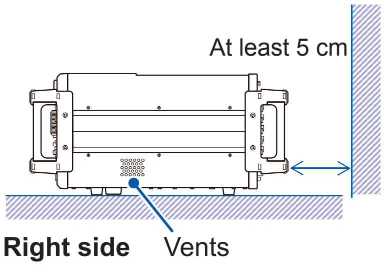
Do not place the instrument in a location that is unstable or inclined. Do not place the unit on another unit. Knocking-over or dropping the instrument can cause injury or damage to the instrument.

Installation

Be sure to keep the specified clearances around the instrument to prevent overheating.

- Do not install the instrument with any side except the bottom facing down.
- Do not obstruct vents.
- Do not install the instrument at an angle.





Handling the Instrument and Modules

⚠DANGER

- **Do not exceed the range of the specifications and the rated value of the cable or the module.**
  Otherwise, the instrument may be damaged or may produce heat, resulting in personal injury.
  The maximum rated voltage to earth does not change when an attenuator or similar is used at the input. Take the connection method into consideration and make sure that the rating is not exceeded.
- **To avoid electric shock, ddo not remove the instrument’s cover and the module case.**
  The internal components of the instrument carry high voltages and may become very hot during operation.

- **It is recommended to measure the secondary side of a distribution panel with the U8974 High Voltage Unit. Do not connect the connection cords on the primary side of the distribution panel because an unrestricted current flow can damage the connection cords and facilities if a short-circuit occurs.**

⚠WARNING

- **Each channel of Model U8979 Charge Unit has the BNC terminal and miniature connector terminal with the common ground. Do not connect cords with each of the terminals simultaneously to avoid a short-circuit.**

- **To avoid electric shocks, confirm that the module is turned off and the connection cables are disconnected before removing or replacing a module.**
- **To avoid electric shocks, never operate the instrument with a module removed. To use the instrument after removing a module, install a blank panel over the opening of the removed module.**
- **To prevent instrument damage or electric shocks, use only the screws for securing the module in place that shipped with the instrument.**
  If you lose any screw or find that any screws are damaged, please contact your Hioki distributor for a replacement.
- **Setting the measurement mode to [PreAmp] allows Model U8979 Charge Unit to constantly provide power (3.0 mA, 22 V) to sensors. Set any measurement mode other than [PreAmp] or tum off the instrument before connecting a sensor or probe with a BNC terminal to avoid an electric shock or damage to the measurement target.**

⚠CAUTION

- To avoid damaging modules, do not touch the module connectors on this instrument.

- Model U8979 Charge Unit has miniature connectors with the maximum input charge of ±500 pC (for six higher-sensitivity range) or ±50,000 pC (for six lower-sensitivity range). Inputting a charge that exceeds these value causes damage to the instrument.
- Use an acceleration sensor with a built-in pre-amplifier that conforms to the specification of Model U8979 (3.0 mA, 22 V). Using a inapplicable sensor may cause damaging itself.
- To avoid damage to the instrument, protect it from physical shock during transport and handling. Be especially careful to avoid physical shock from dropping.
- The mounting screws must be firmly tightened or the module may not perform as specified or may fail.

- Before transporting the instrument, disconnect all cables and remove any CF cards, USB memory sticks, and recording paper.
- When there is no input, the waveform might be unstable due to the induced voltage, but this is not an error.
- This instrument may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Handling the Printer and Recording Paper

⚠WARNING

The print head and surrounding metal parts can become hot. Be careful to avoid touching these parts.

⚠CAUTION

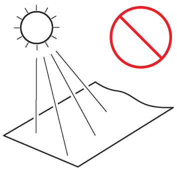
Be careful not to cut yourself with the paper cutter.

- Please use only the specified recording paper. Using non-specified paper may not only result in faulty printing, but printing may become impossible.
- If the recording paper is skewed on the roller, paper jams may result.
- Always use the paper cutter to cut the printed paper. Excessive paper dust can accumulate on the roller if the paper is cut by the print head, which may result in paper jams or white streaks in the printing.

Storing Data Recordings

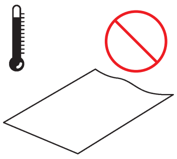
The recording paper is thermally and chemically sensitized. Observe the following precautions to avoid paper discoloration and fading.

- To avoid discoloration, do not expose it to direct sunlight. Store below 40°C (104°F) and 90% RH.
- Store away from dew and damp places.
- Make photocopies of recording printouts that are to be handled or stored for legal purposes.
- If the thermal paper is exposed to an organic solvent such as alcohol or ketone, it may no longer develop properly, and recorded data may fade. Pressure sensitive tapes such as flexible PVC films and scotch tapes must be handled with care as they contain organic solvents.
- Also, the thermal recording paper is ruined by contact with wet Daizo copy paper.



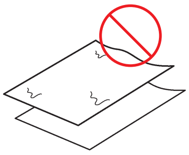
Avoid exposure to direct sunlight.

Avoid exposure to volatile organic solvents like alcohol, ethers, and ketones.



Do not store thermal paper above 40°C and 90% RH.

Avoid contact with adhesive tapes like soft vinyl chloride and cellophane tape.



Avoid stacking with wet Diazo copy paper.

Storing Recording Paper

- Store thermal paper where its temperature will not exceed 40°C (104°F).
- The paper will deteriorate if exposed to light for a long time, so do not remove rolls from their wrappers until ready to use.Handling Media

Handling Media

⚠CAUTION

- Do not remove the media while it is being accessed by the instrument (while the **SAVE** key is lit in blue). Data on the media could be lost.
- Do not turn off the power to the instrument while the media is being accessed by the instrument (while the **SAVE** key is lit in blue). Data on the media could be lost.
- Do not transport the instrument while a USB memory stick is connected. Damage could result.
- Exercise care when using such products because static electricity could damage the external media or cause a malfunction of the instrument.
- Do not subject the SSD to extreme shock or vibration. Doing so may damage the hard disk.

IMPORTANT

- No compensation is available for loss of data stored on the built-in drive (SSD) or removable media, regardless of the content or cause of damage or loss. Be sure to back up any important data stored on the built-in drive (SSD) or removable media.
- Use only CF Cards (no adapter will be required when the card is inserted into the instrument.) or a USB memory stick sold by Hioki.
- Compatibility and performance are not guaranteed for PC cards or USB memory sticks made by other manufacturers. You may be unable to read from or save data to such cards.
  ■Hioki optional CF cards (The CF card includes an adapter.)
  Model 9728 PC Card 512M, Model 9729 PC Card 1G, Model 9830 PC Card 2G
- ■Hioki optional USB memory stick
  Model Z4006 USB Drive 16GB
- With some external media, the instrument may not start up if power is turned on while the external media is inserted. In such a case, turn power on first, and then insert the external media. Prior testing is recommended.
- Unusual USB memory sticks, such as those that require fingerprint authentication or a password, cannot be used.
- When saving or loading data, insert the storage media before selecting it. If the media is not inserted, the file list display will not appear.
- All media (built-in drive, USB memory stick and CF card) have a limited service life. After extensive use over a long period, data retention and readout may become stop working. In such cases, you should procure new media.
- The built-in drive (SSD) is a consumable part. When the written data reaches the capacity (about 60 TB), no more data can be recorded. In such a case, the SSD should be replaced with a new one.
- When the instrument is turned off for a long time (more than one year), the data stored on the built-in drive (SSD) may be lost. Be sure to back up the data if the instrument is left turned off for a long time.
- Automatic saving of data is possible only on built-in drive (SSD), USB memory stick and CF card media.

Before Connecting Cables

⚠DANGER

<u>**When measuring power line voltage**</u>

- **Connecting cables should only be connected to the secondary side of a breaker Even if there is a short circuit on the secondary side of the breaker, the breaker cuts off the electric supply. Do not connect to the primary side of a breaker because unrestricted current flow could damage the instrument and facilities if a short circuit occurs.**
- **To prevent electrical shocks and personal injury, do not touch any input terminals on the VT (PT), CT or the instrument when they are in operation.**
- **Do not permanently connect the instrument in an environment where voltage surges exceeding the maximum input voltage may occur. Failure to observe this precaution could result in damage to the instrument or personal injury.**

- **Do not short-circuit two wires to be measured by bringing the connection cables into contact with them. Arcs or such grave accidents are likely to occur.**
- **To avoid short circuit or electric shock, do not touch the metal parts of the connecting cable clips.**
- **To avoid electrical shocks, be careful to avoid shorting live lines with the connection cables.**

⚠WARNING

- **To avoid electric shock and short-circuit accidents, use only the specified test leads to connect the instrument input terminals to the circuit to be tested.**
- **To avoid electric shock, do not exceed the lower of the ratings shown on the instrument and connection cords.**

To prevent an electric shock accident, confirm that the white or red portion (insulation layer) inside the cable is not exposed. If a color inside the cable is exposed, do not use the cable.

⚠CAUTION

- The cable is hardened under the 0°C (32°F) or colder environment. Do not bend or pull cables in such environments to avoid tearing insulation or breaking the cable.
- <u>Connecting to the BNC jacks on modules</u>
  Do not use a metal BNC connector. If you connect a metal BNC cable to an insulated BNC connector, the insulated BNC connector can be damaged and the instrument may be damaged.

- To prevent cable damage, do not step on cables or pinch them between other objects. Do not bend or pull on cables at their base.

IMPORTANT

- Use only the specified connection cables. Using a non-specified cable may satisfy the specification requirements due to poor connection or other reasons.
- For detailed precautions and instructions regarding connections, refer to the instruction manuals for your modules, connection cables, etc.

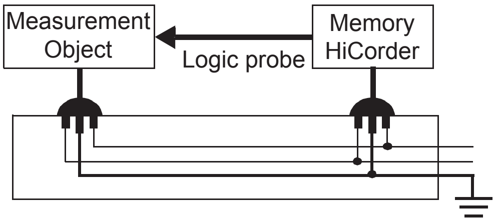
Before Connecting a Logic Probe to the Measurement Object

⚠DANGER

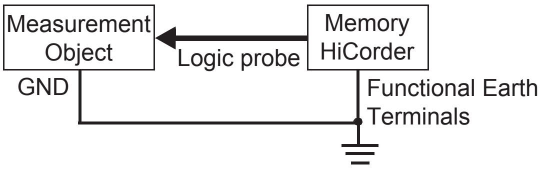
To avoid electric shock and short circuit accidents or damage to the instrument, confirm the following:

- **The ground pin in the LOGIC connector (plug) of Models 9320-01 and 9327 Logic Probes is not isolated from the instrument's ground (common ground). Use grounding-type polarized power cords for the measurement object and this instrument, and obtain power from the same mains circuit.**
  Connecting to different mains circuits or using a non-grounding power cord may cause damage to the measurement object or this instrument because of current flow through the logic probes resulting from potential difference between the grounds of the different wiring systems.
  To avoid these problems, we recommend the following connection procedure:

Connect this instrument to the same outlet as the measurement object using the (supplied) grounding polarized power cord.



Connect the measurement object's ground to the GND terminal (functional earth terminal) of this instrument.
(Always obtain power from the same mains circuit.)
See "2.5.2 Ground the Functional Earth of This Instrument" (page 50)



Before Turning the Power Supply On

⚠WARNING

- **To avoid electrical accidents and to maintain the safety specifications of this instrument, only connect the provided power cord to an outlet.**
- **Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.**

⚠CAUTION

Avoid using an uninterruptible power supply (UPS), DC/AC inverter with rectangular wave or pseudo-sine-wave output to power the instrument. Doing so may damage the instrument.

To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.

Turn off the power before connecting or disconnecting the power cord.

Before Connecting to an External Device

⚠DANGER

To avoid electrical hazards and damage to the instrument, do not apply voltage that exceeds the maximum input voltage to the external control terminals.

	I/O terminals	Maximum input voltage
Instrument	START/.IN1	-0.5 V to 7 V DC
	STOP/IN2	-0.5 V to 7 V DC
	PRINT/.IN3	-0.5 V to 7 V DC
	GO/OUT1	50 V DC, 50 mA DC, 200 mW
	NG/OUT2	50 V DC, 50 mA DC, 200 mW
	EXT.SMPL	-0.5 V to 7 V DC
	TRIG OUT	50 V DC, 50 mA DC, 200 mW
	EXT.TRIG	-0.5 V to 7 V DC
U8793 Arbitrary Waveform Generator Unit	IN	-0.5 V to 7 V DC
	OUT	30 V DC, 50 mA DC

⚠WARNING

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to external control terminals or external connectors.

- **Always turn off the power to the instrument and to any devices to be connected before making connections.**
- **Be careful to avoid exceeding the ratings of external control terminals and external connectors.**
- **The external control terminals use the same GND as the instrument. Ensure that devices and systems to be connected to the external control terminals are isolated as required.**

⚠CAUTION

To avoid equipment failure, do not disconnect the USB cable while communication is in progress.

- Use a common ground for both the instrument and the connection equipment. Use of different ground circuits will result in a potential difference between the instrument's ground and the connected equipment's ground. If the cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.
- While connecting or disconnecting the cables, ensure that the power supply of the instrument and the device to be connected is cut off. This may cause damage or malfunctioning.
- After connecting the communications cable, tighten the screws on the connector securely. Failure to secure the connector could result in equipment malfunction or damage.

Disc Precautions

- Keep the recorded side of discs free of dirt and scratches. When writing text on a disc's label, use a pen or marker with a soft tip.
- Keep discs inside a protective case and do not expose to direct sunlight, high temperatures, or high humidity.
- Hioki is not liable for any issues your computer system experiences in the course of using this disc.

When the Instrument is Not Used for a Long Period

- To avoid straining some parts of the printer, and to prevent dirt adhering to the print head, close the printer cover.
- Perform three or four test prints (printer check) before using a printer that has been in storage for a long period.

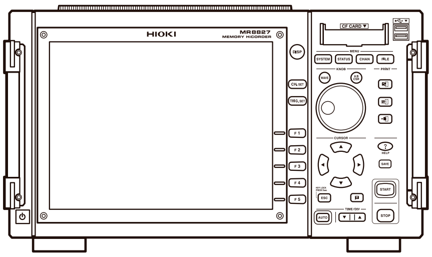
Precautions During Shipment

Keep the packing material that was used for shipping this instrument because you may need to use it when transporting the instrument in the future.

1 Overview

1.1 Product Overview

The MR8827 Memory HiCorder is an instrument that allows simultaneous measurement of multiple signals. The MR8827 is easy to operate and allows quick and efficient measurement and analysis.
Its major uses are monitoring, facility diagnosis and various tests.



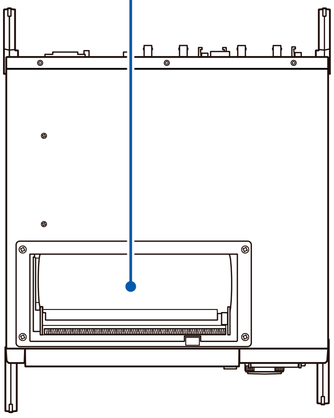
Isolated 32 analog channels	The unit is electrically isolated from the channels.
Measurement possible using up to 28 analog channels and 64 logic channels	All channels can be measured simultaneously.
Selectable module according to the measurement details	Modules can be selected from fourteen types.
High-speed sampling: 20 MS/s	Reliable response evaluation is possible.
Easy loading of recording paper **High-speed printing**	One-touch insertion allows quick and trouble-free operation.
Arbitrary Waveform Generator Unit can output the measured data	You can simulate actual waveforms.

(When Model U8350 Printer Unit is installed)

1.2 Part Names and Functions

Top

Model U8350 Printer Unit (Optional)



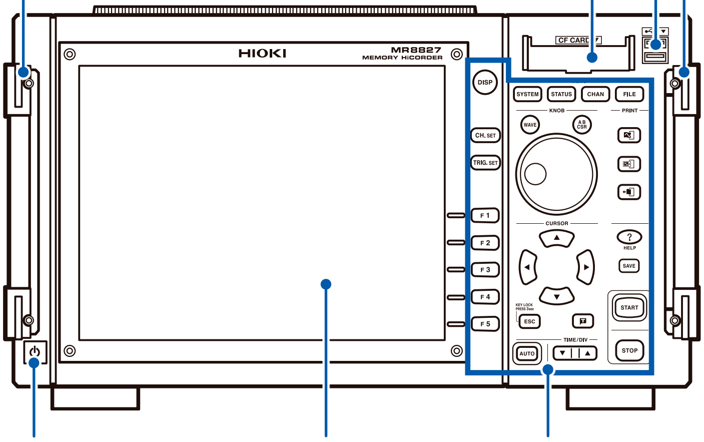
Front Side

USB connector (Type A)
Connect USB memory stick and USB mouse here. (p. 46)

Handle

Handle

CF card slot



POWER switch (p. 51)

Display

Operation key (p. 19)

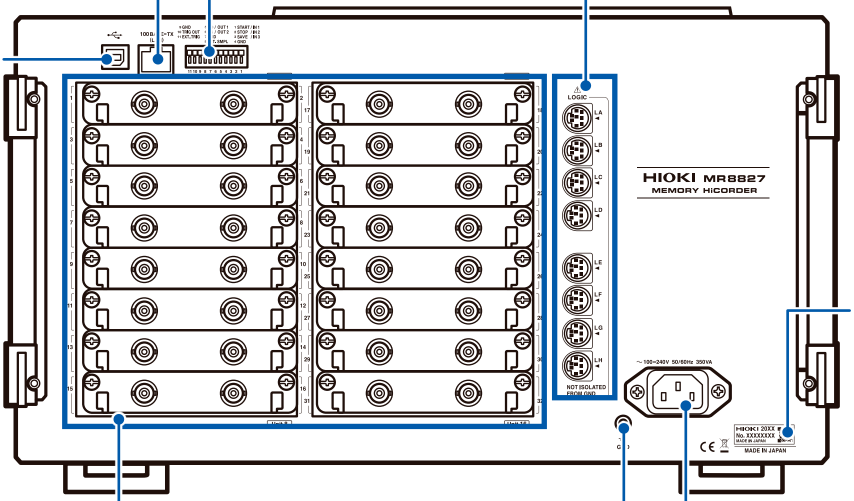
Back Side

100BASE-TX connector
Connect LAN cable here.
(p. 317)

External control terminals
An external sampling signal can be connected here. (p. 343)
Allows control of the unit.

Standard LOGIC terminals ⚠
Input connectors for optional proprietary logic probes.
(p. 30)

USB connector (Type B)
Connect to the computer (PC) with the USB cable.
(p. 336)



Serial No.*
Do not remove this label, as it is required for product support.

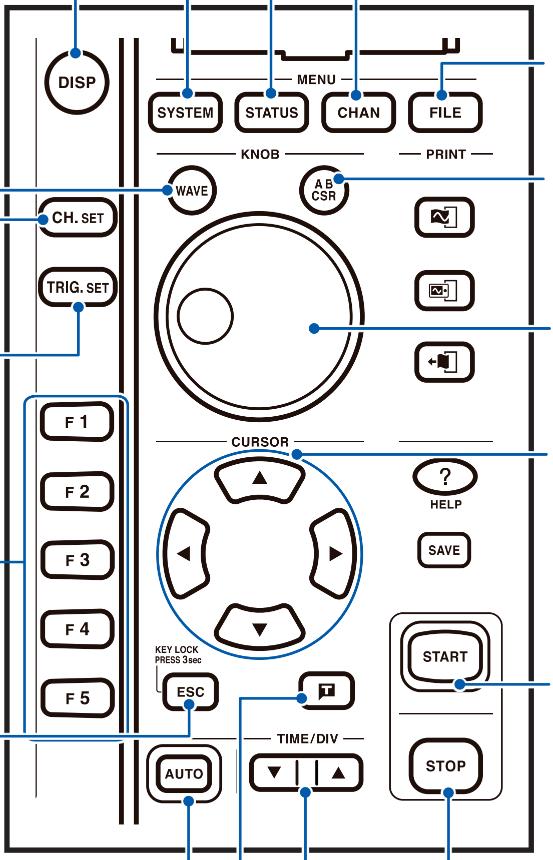
Various modules ⚠ **(p. 28), (p. 30)**
(For details, see the instruction manual of the respective module.)

GND terminal (Functional earth terminal)
Connect to Earth ground. (p. 50)

Power inlet ⚠
Connect the supplied power cord here. (p. 50)

*The serial number consists of 9 digits. The first two (from the left) indicate the year of manufacture, and the next two indicate the month of manufacture. Required for product control. Do not peel off the label.

Operation Keys



DISP key
Displays the Waveform screen

WAVE key
(Lights up in red when selected)
Assigns the jog and shuttle knobs to waveform scrolling. (p. 132)

CH.SET key
Displays the channel settings window on the Waveform screen. (p. 66)

TRIG.SET key
Displays the trigger settings window on the Waveform screen. (p. 195)

F key
Select setting items

ESC key
Cancels an operation.
Removes the displayed dialog and window.

KEY LOCK
When the **ESC** key is pressed for three seconds, the keys are locked.
To cancel the lock, press the **ESC** key again for three seconds.

AUTO key
Starts auto-range measurement (p. 76)

TIME/DIV key
Sets the time axis.

Manual Trigger key
Issues a manual trigger event. (p. 208)

SYSTEM key
Displays the System screen (p. 313)

STATUS key
Displays the Status screen

CHAN key
Displays the Channel screen

FILE key
Displays the File screen (p. 103)

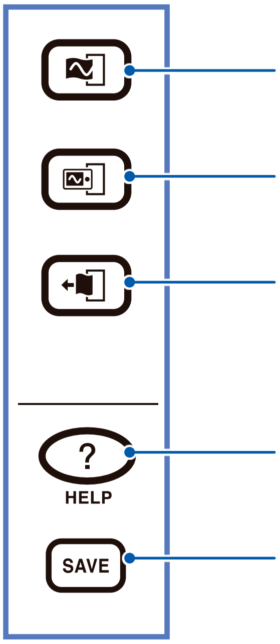
AB CSR key
(Lights up in red when selected)
Sets AB cursors (p. 128)

Inner: Jog
Outer: Shuttle
Scrolls waveforms (p. 132)

CURSOR key
Moves the cursor up, down, left and right on the screen.

START key
Starts Measurement
Lights up green during measurement.
Refer to (p. 315).

STOP key
Stops Measurement
Press once:
Measurement stops after the set recording length
Press twice:
Stop measurement
Refer to (p. 315).



PRINT key
Prints waveforms and lists (p. 113)

COPY key
Prints a hard copy of the display screen (p. 124)

FEED key
Feeds paper

HELP key
Opens help information (p. 24)

SAVE key
(Lights up in blue while media is being accessed.)
Saves data to storage media. (p. 83)
Turns dialog box display during auto-save on or off.

1.3 Screen Organization

The screen configuration is as listed below. Each screen or window appears when the listed key is pressed.
The trigger settings window and channel settings window can be brought up on the Waveform screen.

Waveform Screen

DISP

Use this screen to view the waveform.
The settings window on the right displays the current measurement parameters.

Trigger Settings Window, Channel Settings Window

TRIG. SET View the trigger settings.

CH. SET View the analog channel and logic channel settings.

Status Screen

STATUS

View and update measurement and calculation settings.
Each push of the **STATUS** key cycles through the following sheets:
[Status] sheet, **[Num Calc]** sheet, **[Memory Div]** sheet, **[Wave Calc]** sheet.

Channel Screen

CHAN

View and update channel, scaling, and comment settings.
Each push of the **CHAN** key cycles through the following sheets:
[Unit List] sheet, **[Each Ch]** sheet, **[Scaling]** sheet, **[Comment]** sheet.

System Screen

SYSTEM

View and update environment settings, save and print files, choose interface settings, and perform data initialization.
Each push of the **SYSTEM** key cycles through the following sheets:
[Environment] sheet, **[File Save]** sheet, **[Printer]** sheet, **[Interface]** sheet, **[Init]** sheet.

File Screen

FILE

View saved data files (CompactFlash cards, built-in drive, USB memory stick, internal memory).

Explanation of Screen Contents

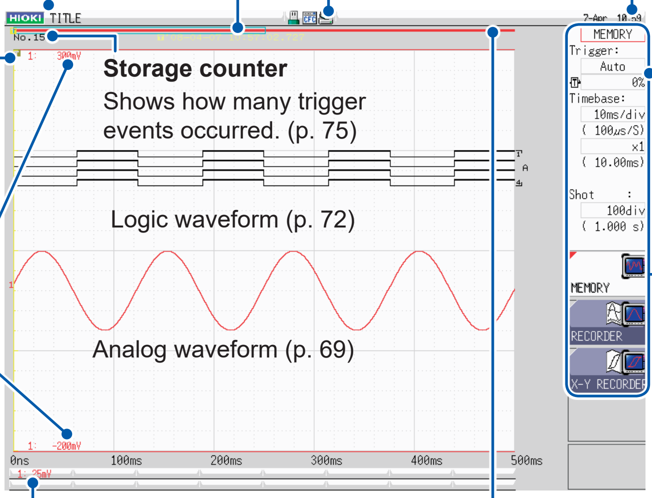
Waveform Screen

Title comment
Shows the specified title comment. (p. 146)

Trigger time
Shows the date and time of the last trigger event. (p. 195)

Media icon
Shows the media status. (p. 46)

Current date and time
Shows the internal clock date and time. (p. 52)



MEMORY
Trigger: Auto
0%
Timebase: 10ms/div
(100µs/S)
x1
(10.00ms)
Shot : 100div
(1.000 s)

Storage counter
Shows how many trigger events occurred. (p. 75)

Logic waveform (p. 72)

Analog waveform (p. 69)

Trigger marker
Shows the point where the trigger event occurred. (p. 195)

Upper and lower limits
The upper and lower limit values for each channel are shown here. (p. 142)

Settings cursor
The current cursor location flashes.

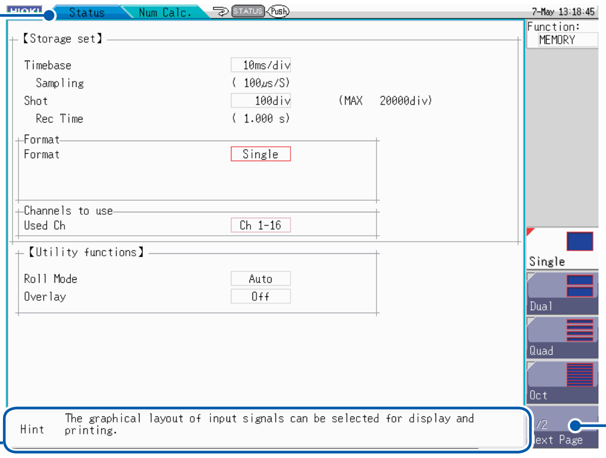
Settings window
Set measurement conditions as follows. (p. 58)

Vertical axis display 1: 25mV
Shows the value per increment for each channel. This is linked to the range setting. (p. 69)

Scroll bar
Stored waveforms are indicated by red bars. The displayed waveform is indicated by a blue frame. (p. 132)

Elements Common to the Status, Channel, System, and File Screens

Sheet tab
Shows names of sheets that can be selected. Use the **MENU** keys to switch between sheets.



Function: MEMORY

【Storage set】
Timebase 10ms/div
Sampling (100µs/S)
Shot 100div (MAX 20000div)
Rec Time (1.000 s)
Format
Format Single
Channels to use
Used Ch Ch 1-16
【Utility functions】
Roll Mode Auto
Overlay Off

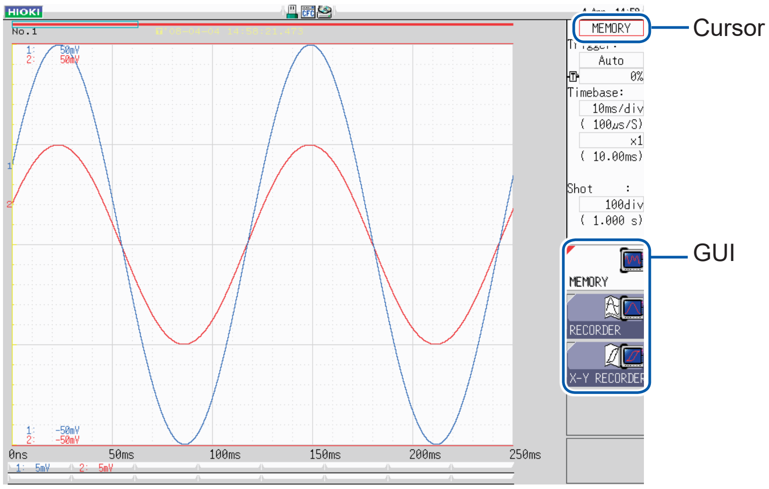
Hint The graphical layout of input signals can be selected for display and printing.

Next page
This is displayed if there are more than five setting items. This button brings up the next group of items.

Hint
Shows details about the item at the current settings cursor position. Messages such as “Online,” “Key Lock active.” and error messages are also shown here.

1.4 Basic Key Operations

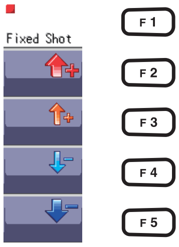
1 **Press the CURSOR key and move the cursor to the item you want to change.**



2 **Check the interface and press the function key (F key) for the setting you want to change.**

The assignment of the **F** keys is different for each item.

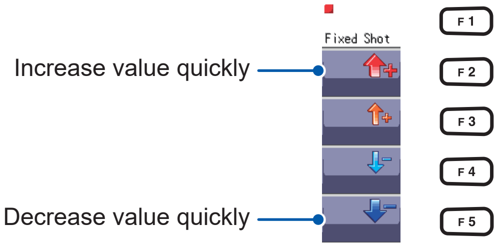
Selecting a Setting Item



Press the **F** key to change the setting item.

When there are more than five setting items, press **F5 [Next Page]** key to switch to the next page.

Increasing or Decreasing a Setting Value



Press the **F** keys to change the setting value.

3 **For some setting items, the CH.SET key selects [Exec] and the TRIG.SET key selects [Cancel].**

To enter text or numbers

Refer to "8.1.3 Alphanumeric Input" (p. 149).

1.4.1 Using the HELP Key

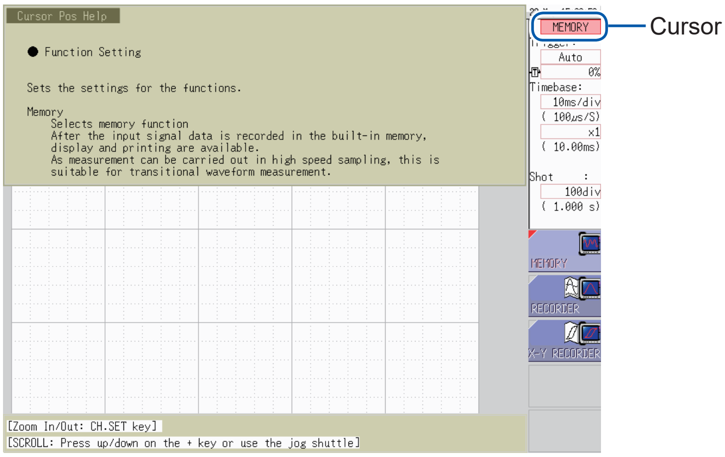
When you press the Help key a simple explanation will appear at the cursor position.

Cursor Position Help

1 **Move the cursor to the item for which you want to display help.**

2 **Press the HELP key. A [Cursor Pos Help] sheet is displayed at the cursor position.**

You can scroll the information using the **CURSOR** up/down keys or the jog knob.



Cursor Pos Help

● Function Setting

Sets the settings for the functions.

Memory
    Selects memory function
    After the input signal data is recorded in the built-in memory, display and printing are available.
    As measurement can be carried out in high speed sampling, this is suitable for transitional waveform measurement.

[Zoom In/Out: CH.SET key]
[SCROLL: Press up/down on the + key or use the jog shuttle]

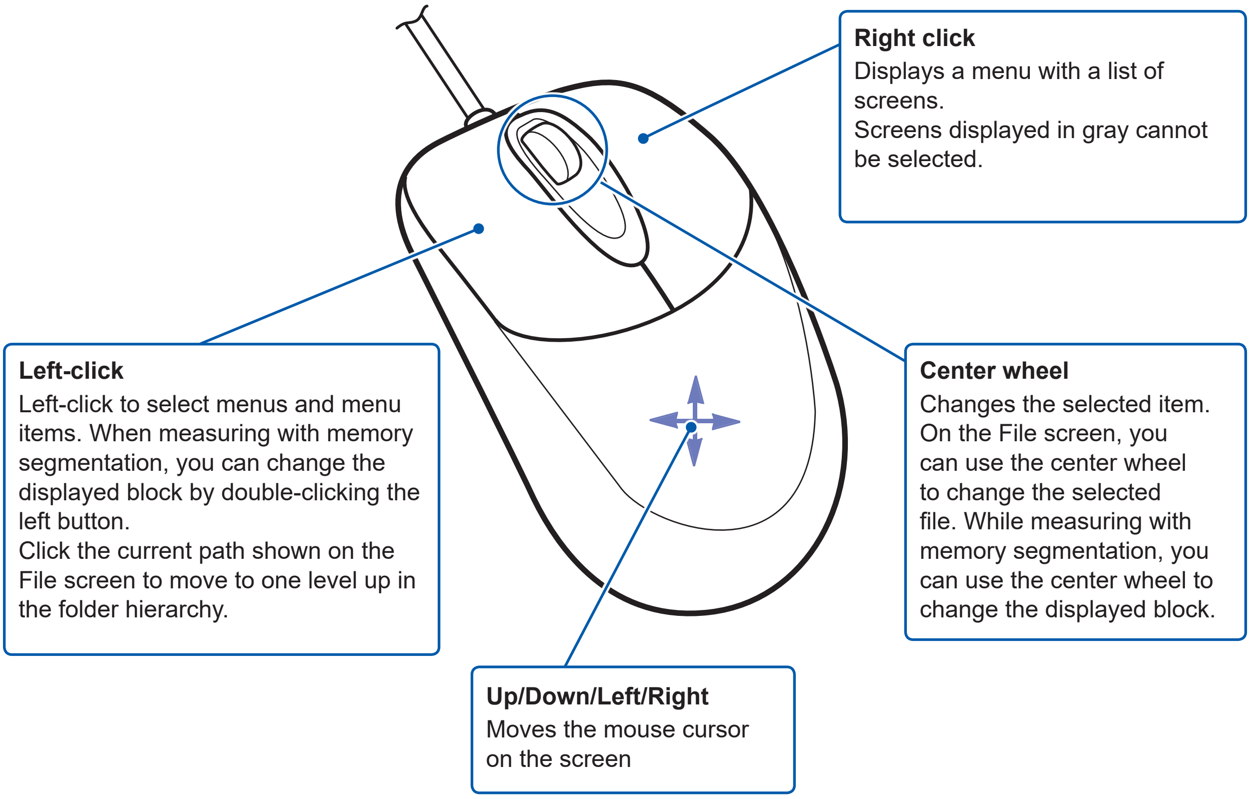
- You can change the size of the Help sheet with the **CH.SET** key. Available settings are full, top half, and bottom half. The example above is for top half.
- Pressing the **HELP** key toggles Cursor Position Help, on and off.

1.4.2 Use a Mouse to Perform Key Operations

You can use a commercially available USB mouse to perform the same operations as the keys on the instrument.

- There are a variety of mice available, and not all devices will work with the instrument.
- The instrument's USB ports are designed exclusively for use with mice and USB memory sticks. Do not connect any other type of device.
- When operating the instrument with the mouse, you may experience temporary delayed operation or corrupted screen display.
- When using a mouse, do not change the interface on the System screen to anything other than “LAN.” You may not be able to use the mouse while USB communications are in progress.
- External interference may cause the mouse to malfunction. Keep the mouse and mouse cable as far away as possible from sources of interference.

To perform operations with a mouse:



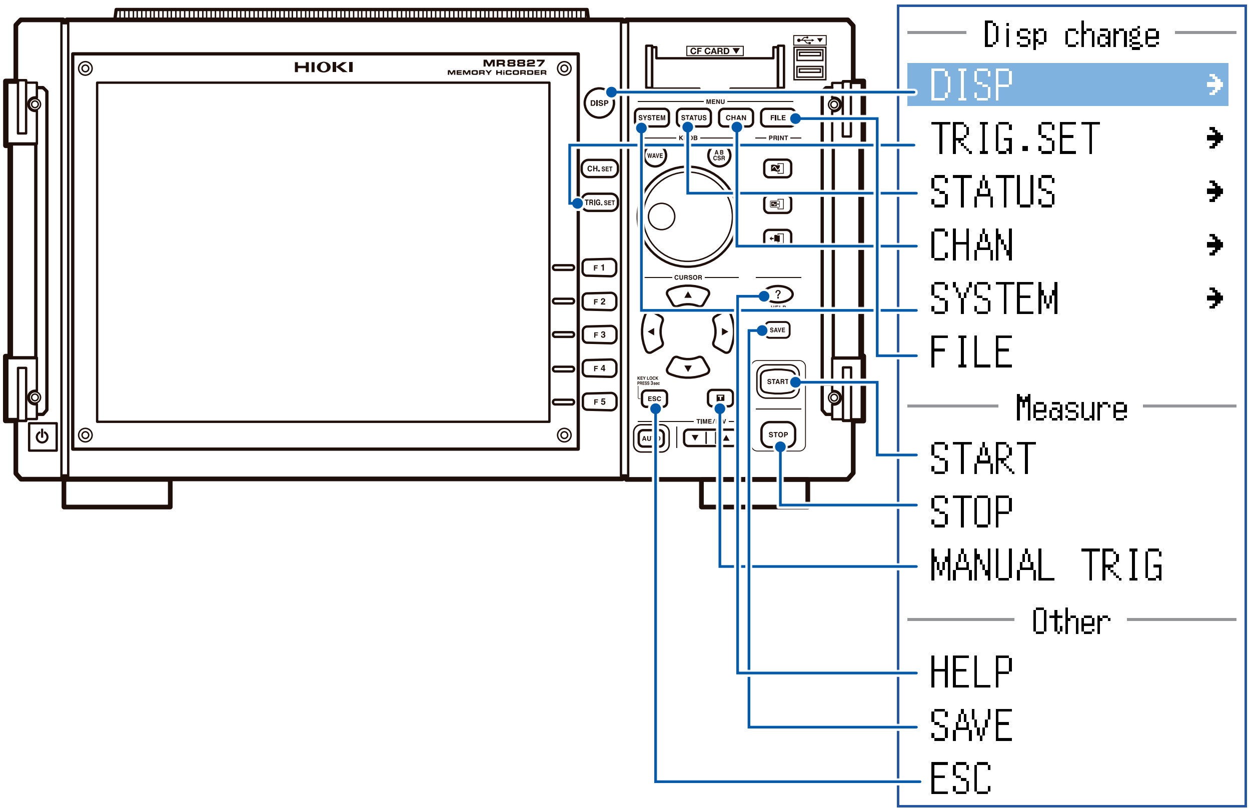
Right click
Displays a menu with a list of screens.
Screens displayed in gray cannot be selected.

Left-click
Left-click to select menus and menu items. When measuring with memory segmentation, you can change the displayed block by double-clicking the left button.
Click the current path shown on the File screen to move to one level up in the folder hierarchy.

Center wheel
Changes the selected item. On the File screen, you can use the center wheel to change the selected file. While measuring with memory segmentation, you can use the center wheel to change the displayed block.

Up/Down/Left/Right
Moves the mouse cursor on the screen

The operation keys of the instrument and the menu displayed when you right-click the mouse are related as follows:



To operate and carry out settings for CH.SET, WAVE, and AB CSR click the icons displayed when a mouse is connected. The operation keys and icons are related as follows:

Icon	Operation key
CH SET	**CH.SET** key
WAVE	**WAVE** key
AB CSR	**AB CSR** key

Useful function

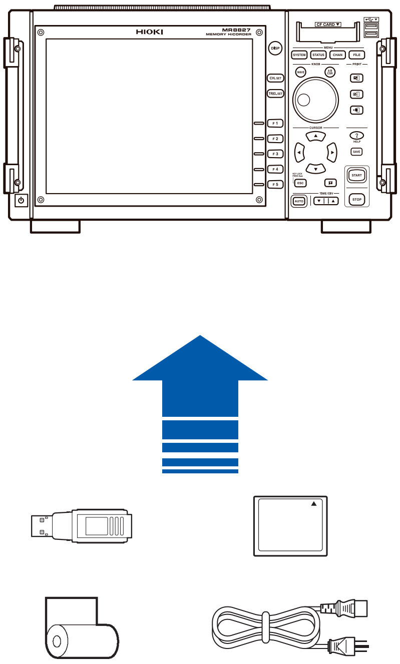
Dragging the right button of the mouse (Holding down the button, moving the mouse rightward, leftward, or upward, and then releasing the button) works the same as the following keys:

Rightward: START
Leftward: STOP
Upward: ESC

2 Measurement Preparation

Procedure

1. **Install this instrument** (p. 7)
2. **Install or remove modules** (p. 28)
   (When adding or replacing modules)
3. **Connect logic probes to the Standard LOGIC terminals** (p. 41)
   (When measuring logic signals)
4. **Connect connection cables to the module** (p. 30)
   (When measuring analog signals)
   Probes and cables will differ depending on the type of measurement being performed.
5. **Insert media (CF card, USB memory stick)** (p. 46)
6. **Load recording paper** (p. 49)
7. **Connect the power cord** (p. 50)
8. **Connect the GND terminal (functional earth terminal).** (p. 50)
   (When measuring in noise-prone environments)
9. **Turn Power On** (p. 51)
10. **Set the clock** (p. 52)
11. **Perform zero-adjust** (p. 53)
    Perform calibration (p. 54)
    (When using Model MR8990)



When preparation is complete, start measurement. (p. 55)

To use communication functions
Refer to “16 Connect to a PC” (p. 317).

To use external control functions
Refer to “17 External Control” (p. 343).

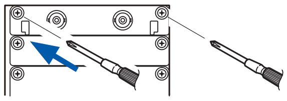
2.1 Install or Remove Modules

Read “Handling the Instrument and Modules” (p. 8) carefully.
Modules specified when the instrument is ordered are supplied preinstalled. Use the following procedures to add, replace, or remove modules from the instrument.

- Up to two logic units can be installed as units 1 to 8. Logic units installed as the other units cannot be used. Other logic units being installed will be disabled.
- For information on the analog channel resolution when logic channels are used, refer to “8.10 Detailed Settings for Modules” (p. 170).

To Install a Module

Back side

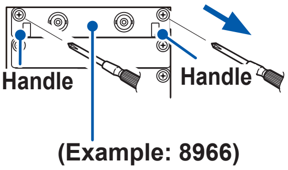


Required items: One Phillips-head screwdriver (No. 2)

1. **Turn off the power to the instrument.**
2. **Correctly orient the module and insert it firmly all the way in.**
   Make certain that the labels on the module's panel face the same direction as the labels on the back side of the instrument.
3. **Using a Phillips screwdriver, tighten the two module mounting screws (M3 × 7.5 mm).**

To Remove a Module

Back side

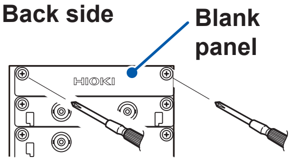


Required items: One Phillips-head screwdriver (No. 2)

1. **Turn off the power to the instrument.**
2. **Remove any connection cables or thermocouples connected to the module.**
3. **Remove the power cord.**
4. **Using a Phillips screwdriver, loosen the two module mounting screws (M3 × 7.5 mm).**
5. **Grasp the handles and pull the module out.**

If not Installing Another Module After Removal

Back side

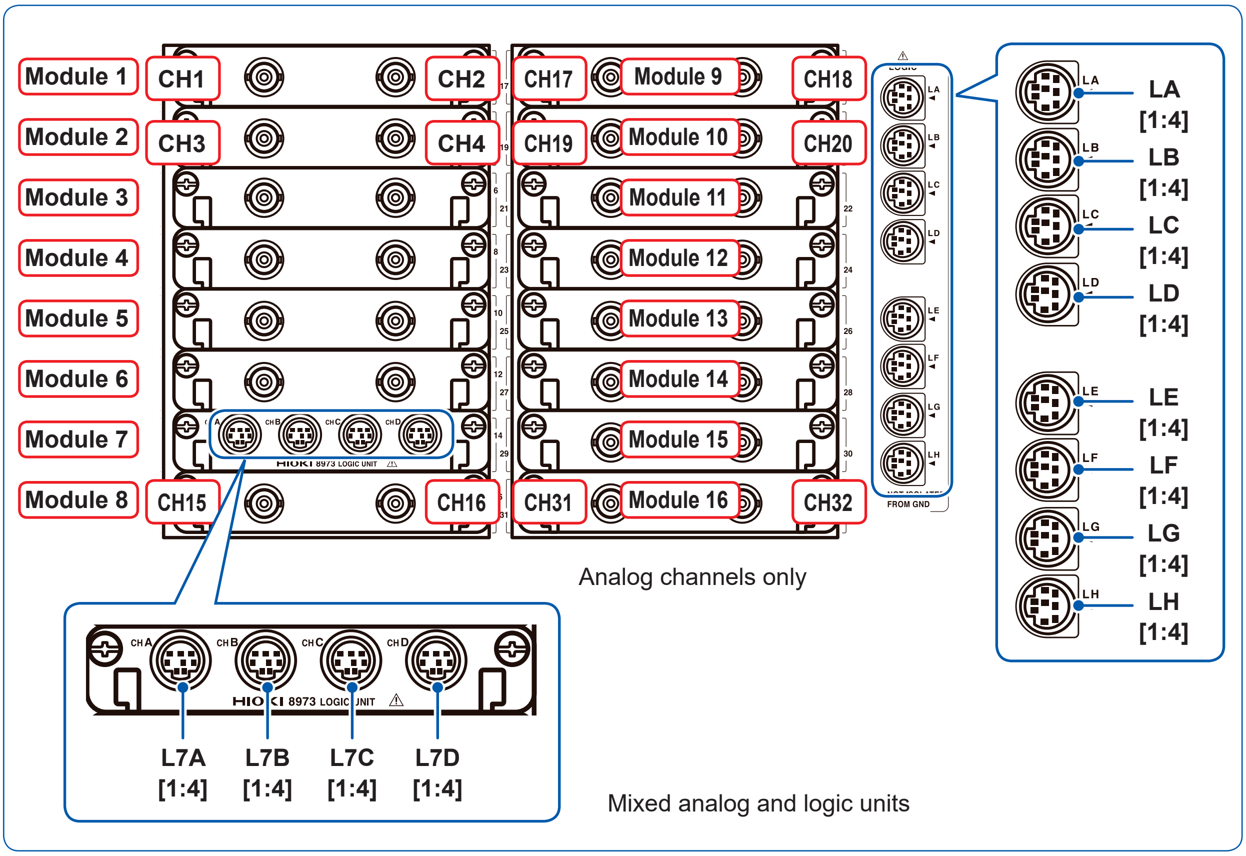


1. **Install a blank panel.**
2. **Using a Phillips screwdriver, tighten the two mounting screws (M3 × 7.5 mm).**

Measurements made without a blank panel installed may fail to meet specifications because of temperature instability within the module.

Channel Allocation

Module number one is at the top, and channel number one is at the top left.
Information about the modules installed in the instrument can be verified in the System Configuration list. (p. 409)



2.2 Connection Cables

Measuring voltage

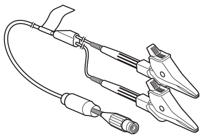
Read Refer to “Before Connecting Cables” (p. 12). carefully.
For detailed precautions and instructions regarding connections, refer to the instruction manuals for your modules, connection cables, etc.

Applicable Modules
- Model 8966 Analog Unit
- Model 8968 High Resolution Unit
- Model 8972 DC/RMS Unit
- Model U8979 Charge Unit

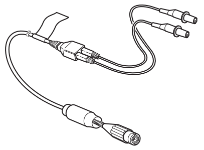
Connect to the BNC jack on a module.

Connect with: connection cables

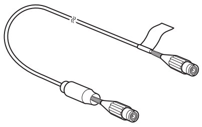
- Model L9197 Connection Cord
  (Maximum input voltage: 600 V)
  Large alligator clip type



- Model L9198 Connection Cord
  (Maximum input voltage: 300 V)
  Small alligator clip type

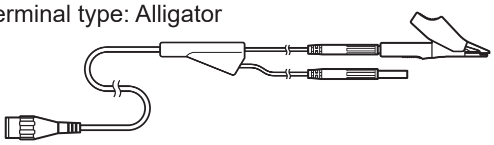


- Model L9217 Connection Cord
  (Maximum input voltage: 300 V)
  For measuring BNC output



- Model L9790 Connection Cord
  (Maximum input voltage: 600 V)
  Terminal type: Alligator, contact, grabber

Example: Terminal type: Alligator

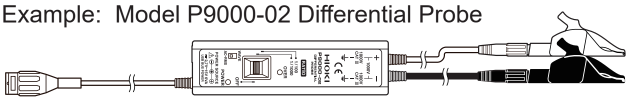


- Model 9166 Connection Cord
  (Maximum input voltage: 30 V AC, 60 V DC)
  Electrical clips

If the voltage to be measured exceeds the maximum input rating of the module being used

- Model 9322 Differential Probe*1
- Model 9665 10:1 Probe
- Model 9666 100:1 Probe
- Model P9000-01/-02 Differential Probe*2

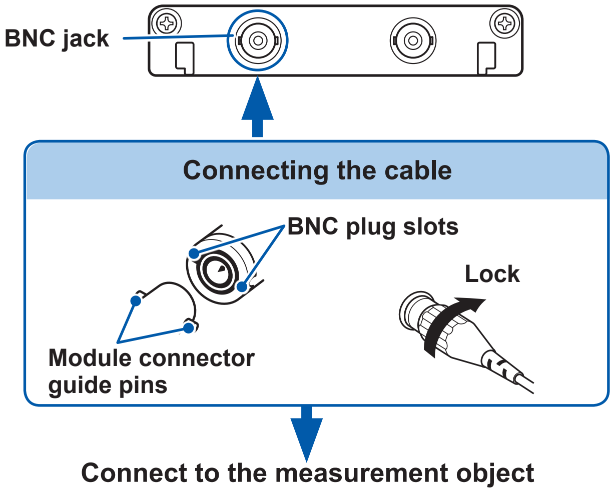
Example: Model P9000-02 Differential Probe



*1 An optional power cord or AC adapter may be required.
*2 An optional AC adapter or a commercially available USB cable is required.

To Connect to a BNC Terminal

Example: Model 8966 Analog Unit


BNC jack
Connecting the cable
BNC plug slots
Lock
Module connector guide pins
Connect to the measurement object

Required tools: One of the above cables

1. **Connect the BNC plug on the cable to a BNC jack on the module.**
2. **Align the slots in the BNC plug with the guide pins on the jack on the module, then push in and twist the plug clockwise until it locks.**
3. **Connect the cable clips to the measurement object.**

To disconnect BNC connectors

Push the BNC plug, twist it counterclockwise, then pull it out.

Measuring Frequency, Number of Rotations and Count

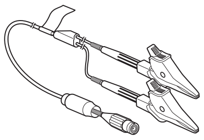
Refer to p. 31 for details about connecting to BNC terminals.

Applicable Modules
- Model 8970 Freq Unit

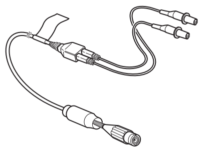
Connect to the BNC jack on a module.

Connect with: connection cables

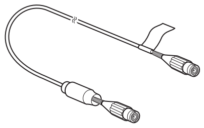
- Model L9197 Connection Cord
  (Maximum input voltage: 600 V)
  Large alligator clip type



- Model L9198 Connection Cord
  (Maximum input voltage: 300 V)
  Small alligator clip type

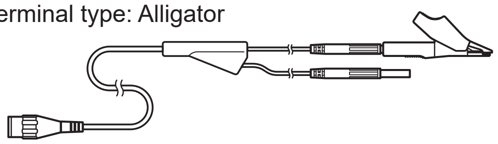


- Model L9217 Connection Cord
  (Maximum input voltage: 300 V)
  For measuring BNC output



- Model L9790 Connection Cable
  (Maximum input voltage: 600 V)
  Terminal type: Alligator, contact, grabber

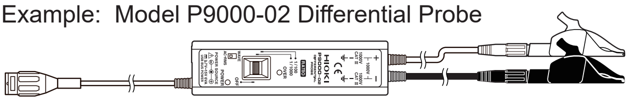
Example: Terminal type: Alligator



If the voltage to be measured exceeds the maximum input rating of the module being used

- Model 9322 Differential Probe*1
- Model P9000-01/-02 Differential Probe*2

Example: Model P9000-02 Differential Probe



*1 An optional power cord or AC adapter may be required.
*2 An optional AC adapter or a commercially available USB cable is required.

Measuring temperature

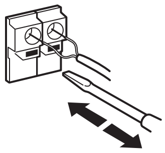
Applicable Modules
- Model 8967 Temp Unit

Connect to the terminal block on the module.

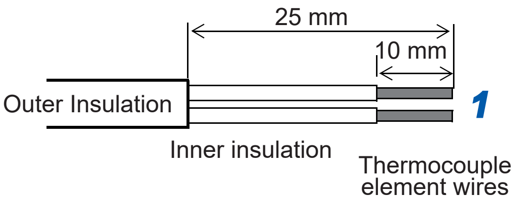
Connect with: thermocouples

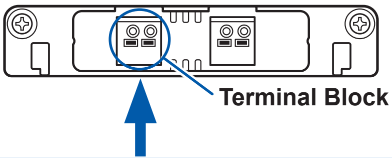
Thermocouple
(Compatible wire: 0.4 mm to 1.2 mm diameter)

Connect to terminal block

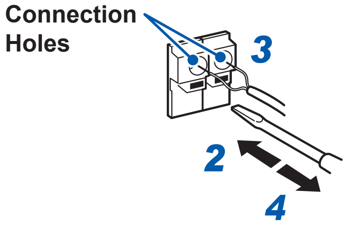


To Connect to the Terminal Block





Connecting a Thermocouple



5 Connect to the measurement object

Required device and tool:
Thermocouple, flat-blade screwdriver (2.6-mm blade)

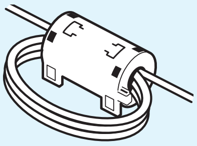
Recommended wire:
Compatible wire: Thermocouple element wires of from 0.4 mm to 1.2 mm in diameter
Stripped length: 10 mm

1. **Strip insulation from the thermocouple wires as shown at the left.**
   Stripped length: approx. 10 mm
2. **Push the blade of a flat screwdriver into the button on the terminal block of the module.**
3. **Insert each thermocouple wire into the appropriate terminal hole while pressing the button. Confirm proper polarity.**
4. **Release the button.**
   The thermocouple is connected.
5. **Connect to the measurement object.**

To remove a thermocouple

Hold the button while pulling the thermocouple wire out.

- If surrounding equipment is affected by noise, coil the thermocouple several times and then attach the included ferrite clamp-on choke (as seen in the diagram to the right).
- When connecting a thermocouple using a wire run of more than 3 meters, take into consideration the EMC environment including possible influence of external noise.



Measuring vibration or displacement with a strain gauge transducer

Applicable Module
- Model U8969 Strain Unit
- Model 8969 Strain Unit

The following device can be connected to the module.

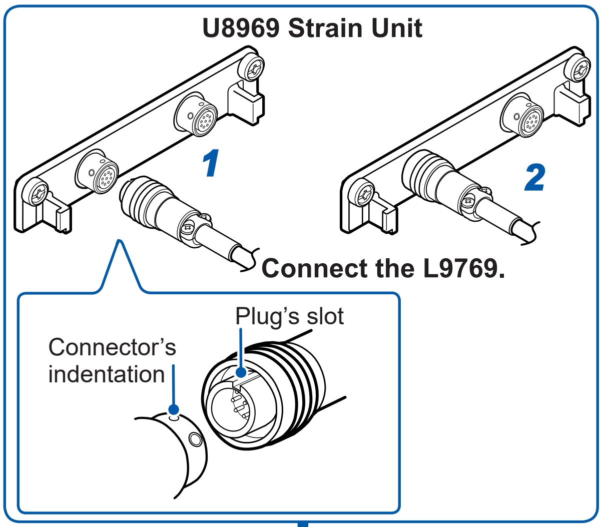
- Strain gauge transducer (Not available from Hioki)

Connect L9769 or 9769 Conversion Cable to the strain gauge transducer.

Connect a strain gauge transducer to a connector on Model U8969 Strain Unit via Model L9769 Conversion Cable; Model 8969 Strain Unit via Model 9769 Conversion Cable.

Connecting the strain gauge transducer to a module’s connector

Example: Connecting the strain gauge transducer to Model U8969 Strain Unit via Model L9769 Conversion Cable



3 **Connect Model L9769 to the strain gauge transducer.**

4 **Connect the strain gauge transducer to a measurement object.**

Required items:
Model L9769 Conversion Cable, strain gauge transducer

1. **Insert Model L9769 into a connector of Model U8969 with the slot of the plug aligned with the outward indentation of the connector.**
2. **Insert the plug into the connector until they are locked together.**
3. **Connect Model L9769 to the strain gauge transducer.**
4. **Connect the strain gauge transducer to a measurement object.**

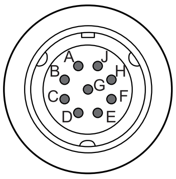
How to disconnect Model L9769

Pull the sleeve of the plug gently, releasing the plug, and disconnect the cable.

The instrument describes Model U8969 as “8969.”

Connector pin-out

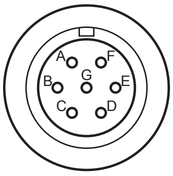
Model U8969 Strain Unit



The metal shell is connected to the GND of the instrument.

Model L9769 Conversion Cable

(Strain gauge transducer end)



Applied voltage:
bridge voltage of 2 V

The metal shell is connected to the GND of the instrument.

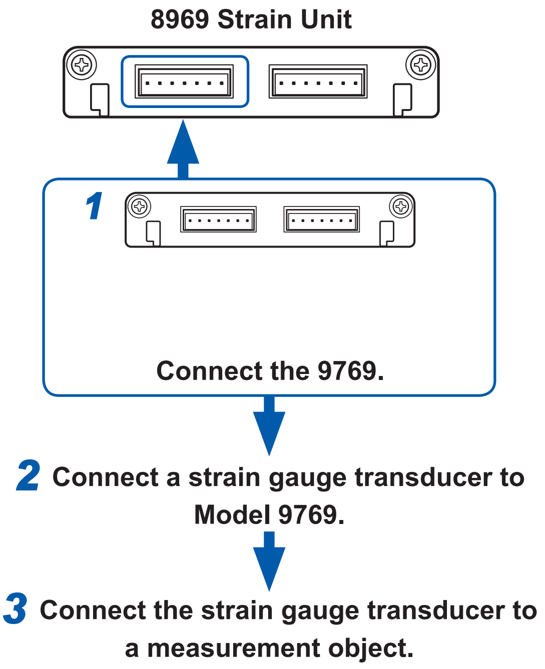
Pin mark	Description
A	BRIDGE+
B	INPUT−
C	BRIDGE−
D	INPUT+
E	FLOATING COMMON
F	SENSE+
G	SENSE−
H, J	N.C.

Pin mark	Description
A	BRIDGE+, SENSE+
B	INPUT−
C	BRIDGE−, SENSE−
D	INPUT+
E	FLOATING COMMON
F, G	N.C.

Connection of Model L9769

- Pin F of the module end is connected with Pin A of the strain gauge transducer end.
- Pin G of the module end is connected with Pin C of the strain gauge transducer end.

Example: Connecting the strain gauge transducer to Model 8969 Strain Unit via Model 9769 Conversion Cable


8969 Strain Unit
1
Connect the 9769.
2 Connect a strain gauge transducer to Model 9769.
3 Connect the strain gauge transducer to a measurement object.

Required items:
Model 9769 Conversion Cable, strain gauge transducer

1 **Connect Model 9769 to a connector on the module.**

Insert the connector of Model 9769 with the orange part facing upward.

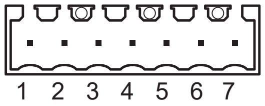
2 **Connect the Model 9769 to the strain gauge transducer.**

3 **Connect the strain gauge transducer to a measurement object.**

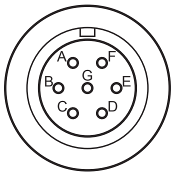
Connector pin-out

Model 8969 Strain Unit

(Pin 1 is on the left when the module's top side is on the up)



Model 9769 Conversion Cable
(Strain gauge transducer end)



Applied voltage:
bridge voltage of 2V

The metal shell is connected to the GND of Model 8969.

Pin No.	Description
1	BRIDGE+
2	SENSE+
3	INPUT+
4	INPUT−
5	BRIDGE−
6	SENSE−
7	FLOATING COMMON

Pin mark	Description
A	BRIDGE+
B	INPUT−
C	BRIDGE−
D	INPUT+
E	FLOATING COMMON
F, G	N.C.

IMPORTANT
- Preforming measurement with a strain gauge requires a bridge box. Use a strain gauge and bridge box both of which are commercially available.
- The bridge box may be susceptible to the effect of noise. For more information about how to ground the bridge box, refer to its instruction manual or contact the manufacturer of the bridge box.

IMPORTANT
Do not excessively bend the cable and the base between cable and connector, pull on them, nor twist them. Doing so may cause the conversion cable to break.

Measuring current

Current sensors that can be connected to Model 8971 Current Unit

The following current sensors can be connected to Model 8971 Current Unit.
Use of conversion cables is required for connecting current sensors.

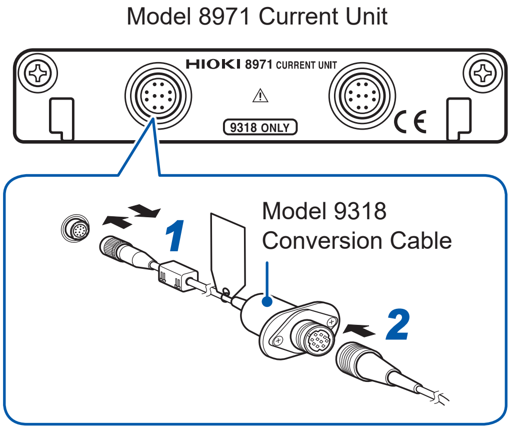
Model number	Model name	Maximum input current / Frequency	Conversion cable for 8971	Connector*[1]
9709	AC/DC Current Sensor	500 A DC to 100 kHz	9318	Plastic
9709-05			CT9901 + 9318	Metal
9272-05	Clamp on Sensor	20 A/200 A 1 Hz to 100 kHz	CT9901 + 9318	Metal
9272-10			9318	Plastic
CT6841	AC/DC Current Probe	20 A DC to 1 MHz	9318	Plastic
CT6841-05			CT9901 + 9318	Metal
CT6843	AC/DC Current Probe	200 A DC to 500 kHz	9318	Plastic
CT6843-05			CT9901 + 9318	Metal
CT6844	AC/DC Current Probe	500 A DC to 200 kHz	9318	Plastic
CT6844-05			CT9901 + 9318	Metal
CT6845	AC/DC Current Probe	500 A DC to 100 kHz	9318	Plastic
CT6845-05			CT9901 + 9318	Metal
CT6846	AC/DC Current Probe	1000 A DC to 20 kHz	9318	Plastic
CT6846-05			CT9901 + 9318	Metal
CT6862	AC/DC Current Sensor	50 A DC to 1 MHz	9318	Plastic
CT6862-05			CT9901 + 9318	Metal
CT6863	AC/DC Current Sensor	200 A DC to 500 kHz	9318	Plastic
CT6863-05			CT9901 + 9318	Metal
CT6865	AC/DC Current Sensor	1000 A DC to 20 kHz	9318	Plastic
CT6865-05			CT9901 + 9318	Metal
CT6875	AC/DC Current Sensor	500 A DC to 2 MHz	CT9901 + 9318	Metal
CT6876	AC/DC Current Sensor	1000 A DC to 1.5 MHz	CT9901 + 9318	Metal

*1: Metal connector (ME15W), plastic connector (PL23)

Connecting current sensors to Model 8971 Current Unit

Current sensors with a black plastic connector, whose model numbers do not end in -05, can be connected to Model 8971 using the optional Model 9318 Conversion Cable*.
Using both Model 9318 Conversion Cable* and CT9901 Conversion Cable, you can connect current sensors with the sub model-number “-05,” which has a metal connector, to Model 8971 Current Unit.

*: Model 9318 Conversion Cable is an accessory of Model 8971 Current Unit.



1. **Aligning the guides of the conversion cable with those of the sensor connector on the module, and straightly insert the plug until it locks.**
2. **Align the guides of the current sensor to be used with those of the conversion cable connector, and straightly insert the plug until it locks.**

   The instrument automatically recognizes the model of the current sensor.
3. **Clamp the current sensor around a line of a measurement target.**

How to disconnect the current sensor

1. **Hold and pull the plastic collar of the conversion cable, which releases the lock, and the remove the connector.**
2. **Hold and pull the plastic collar of the current sensor, which releases the lock, and the remove the connector.**

When measuring current with Model 9018-50 Clamp On Probe

Using Model 9018-50 enables voltage measurement modules such as Model 8966 Analog Unit to measure current.
For more information about how to configure the instrument for use in this type of application, refer to the example settings in “8.5.1 Scaling Examples” (p. 159).

Measuring acceleration

Familiarize yourself with “Operation Precautions” (p. 7) before connecting a current sensor.

Applicable Module
- Model U8979 Charge Unit

The following device can be connected to the module.
- Acceleration sensor (Not available from Hioki)

Connect a acceleration sensor to Model U8979 Charge Unit.

Acceleration sensor connectable with Model U8979

⚠CAUTION

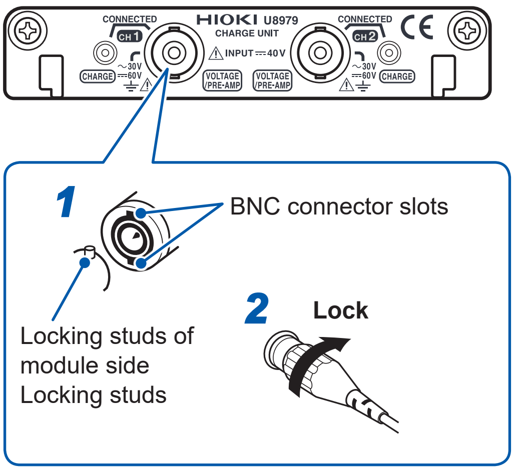
Use an acceleration sensor with a built-in pre-amplifier that conforms to the specification of Model U8979 Charge Unit. Using an inapplicable sensor may cause damaging itself.

Acceleration sensor type	Terminal the sensor is connected to	Note
With a built-in pre-amplifier	BNC connector	Drive power: 3.0 mA, 22 V
Charge output	Miniature connector (#10-32)	–

Connecting an acceleration sensor with a built-in pre-amplifier

Connecting a BNC-output acceleration sensor with a built-in pre-amplifier

Model U8979 Charge Unit



1 **Align the slots in the BNC connector of an acceleration sensor with the locking studs of a BNC connector on the module, and insert the connector.**

2 **Turn the BNC connector of the acceleration sensor clockwise until it locks.**

3 **Attach the acceleration sensor with the built-in pre-amplifier to a measurement target.**

How to remove the acceleration sensor

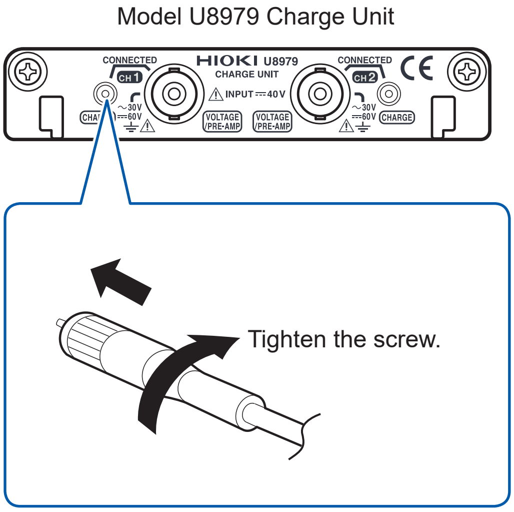
Turn the BNC connector of the acceleration sensor counter-clockwise to release the lock and remove the connector.

Connecting an acceleration sensor other than a sensor with a built-in pre-amplifier

Convert the output connector into the BNC connector using a commercially available conversion connector or conversion cable to connect the sensor.

Connecting a charge-output acceleration sensor

Connecting a charge-output acceleration sensor equipped with the miniature connector (#10-32)



1. **Align the screw of the miniature connector, and turn the connector clockwise to tighten it.**
2. **Attach the charge-output acceleration sensor to a measurement target.**

How to disconnect the current sensor

Turn the miniature connector counterclockwise, and then pull out the connector.

Connecting a charge-output acceleration sensor equipped with a connector other than a miniature connector (#10-32)

Convert the output connector into the miniature connector (#10-32) using a commercially available conversion connector or conversion cable to connect the sensor.

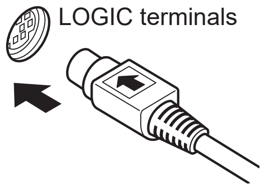
Measuring logic signals

Read “Before Connecting a Logic Probe to the Measurement Object” (p. 13) carefully.
For more information about logic probe specifications, see the instruction manual that came with the logic probe you plan to use.

Applicable Modules
- Model 8973 Logic Unit

LA to LH are supplied as standard equipment with the unit.

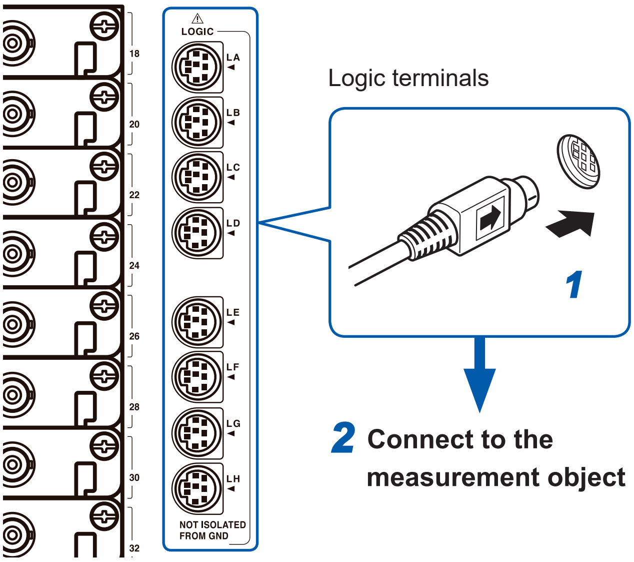
Connect with: Logic Probes
- Model 9320-01 Logic Probe
- Model MR9321-01 Logic Probe
- Model 9327 Logic Probe



To Connect to Logic Terminals

Example: Connecting the 9327 Logic Probe

Back Side



2 **Connect to the measurement object**

Required tools:
Model 9327 Logic Probe

1. **Connect the logic probe by aligning the grooves on the plug and Logic terminal.**
2. **Connect to the measurement object.**

Measuring voltage with a high degree of accuracy (Digital Voltmeter)

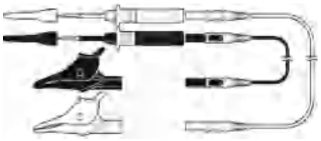
Applicable Modules

- Model MR8990 Digital Voltmeter Unit

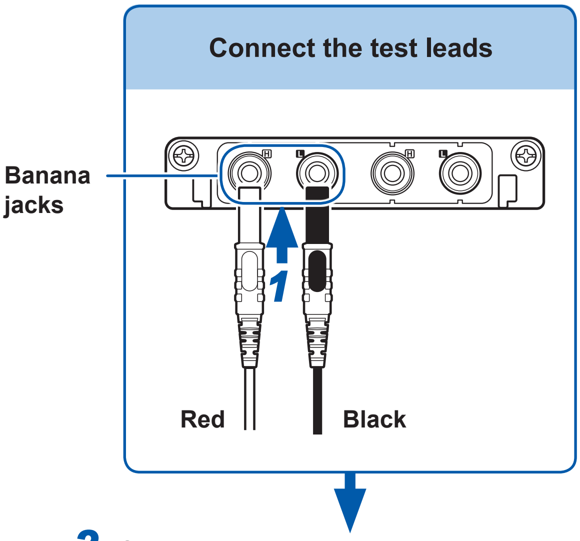
Connect to the banana jacks on a module.

Connect with: Model L2200 Test Leads

- Model L2200 Test Lead (Maximum input voltage: 1000 V)



To Connect to Banana Jacks


Connect the test leads

2 Connect to the measurement object

Required tools: Test leads above

1 **Connect the test leads to the banana jacks on the module.**

Connect the black lead to the L jack, and the red lead to the H jack. Make sure the test lead plugs are fully inserted into the jacks.

Connect the test leads to the object to be measured.

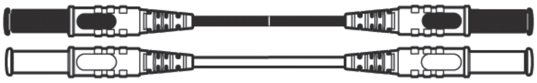
Measuring high voltage

Applicable Module

- Model U8974 High Voltage Unit

Required item: Model L4940 Connection Cable Set

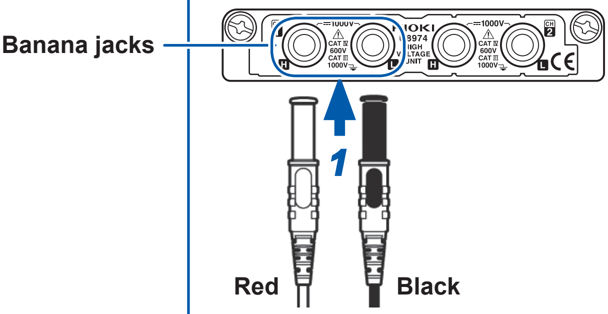
- Model L4940 Connection Cable Set:
  (Maximum input voltage: 1000 V)



Connect to the banana jacks on a module.

To Connect to Banana Jacks

Connect the Connection cable

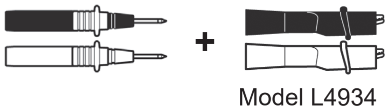
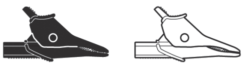
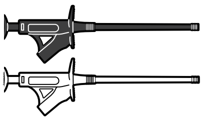
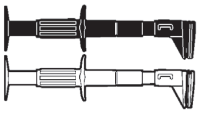
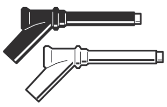
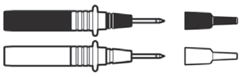


Required items:
Model L4940 Connection Cable Set

1. **Connect the plug of the connection cable to the banana jacks on the module.**

   Connect the terminal and the plug of the same color.
2. **Insert the accessory clip into cable clips.**
3. **Connect the cable clips to the measurement object.**

2 Connect the clip.

Accessory clips	
	Model L4934 Small Alligator Clip Set * Model L4932 is required when using Model L4934.
	Model L4935 Alligator Clip Set
	Model L9243 Grabber Clip
	Model L4936 Bus Bar Clip Set
	Model L4937 Magnetic Adapter Set
	Model L4932 Test Pin Set

3 Connect to the measurement object.

Output Waveform

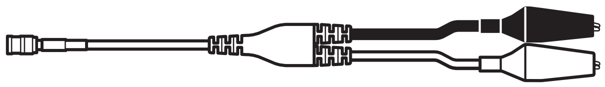
Applicable Modules

- Model U8793 Arbitrary Waveform Generator Unit
- Model MR8790 Waveform Generator Unit

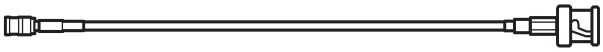
Connect to the SMB jack on a module.

Required item: Model L9795-01 / L9795-02 Connection Cable

- Model L9795-01 Connection Cable (Electrical clips)

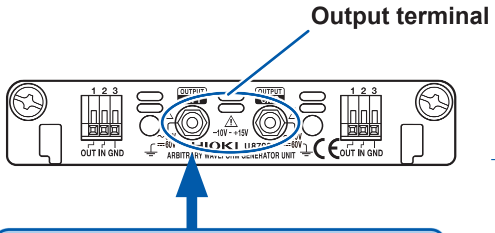


- Model L9795-02 Connection Cable (BNC output)

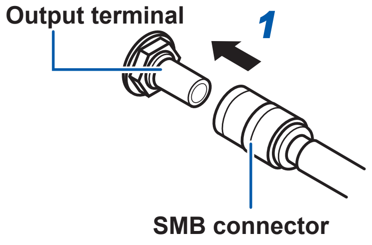


To Connect to Output Terminals

Example: Model U8793



Connect the Connection cable



2 Connect to the object to which the waveform is being applied.

Required items: Connection cable mentioned above

1. **Insert the SMB connector of connection cable in the output terminal of the module until you hear a click.**
2. **Connect the cable clips to the object to which the waveform is being applied.**

To disconnect output connectors

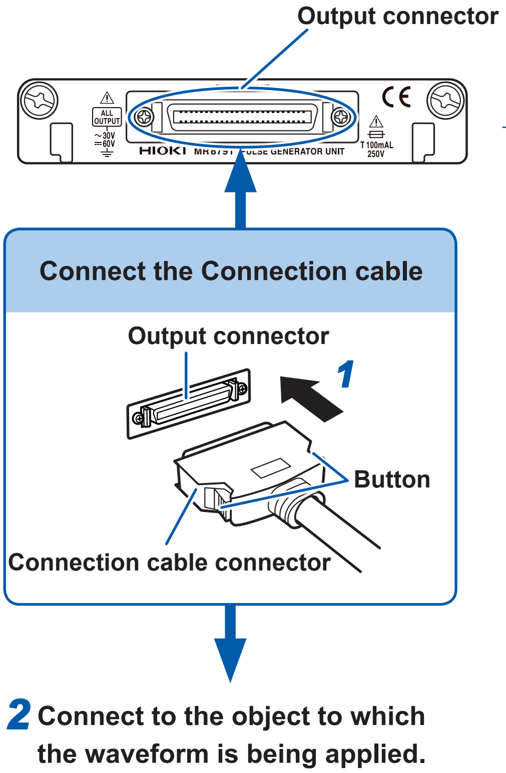
Grip the head of the SMB connector (not the cable), and pull it out.

Output Pulse Waveform

Applicable Module
- Model MR8791 Pulse Generator Unit

Required items: Commercially available cable
(Half-pitch 50 pins)

To Connect to Output Connector


Output connector
HIOKI MR8791 PULSE GENERATOR UNIT
Connect the Connection cable
Output connector
1
Button
Connection cable connector
2 Connect to the object to which the waveform is being applied.

Required items: Commercially available cable

1. **Connect the connection cable to Output Connector of module.**
2. **Connect the connection cable to the object to which the waveform is being applied.**

To disconnect output connectors

Hold the button of connection cable while pulling the connector.

Output connector

10250-52A2PL: 3M products (SCSI-2 connector), (Centronics half-pitch 50 pin socket-contact)
Refer to: “Output Connector Specifications” (p. 33)

- Metal shell of the connector 10250-52A2PL is the same as GND of the instrument (frame GND).
- Use lock type connectors for connecting the harness and the connector.

2.3 Prepare Storage Media

Read “Handling Media” (p. 11) carefully.

2.3.1 Storage Media (Inserting a CF Card and USB Memory Stick)

Media icons

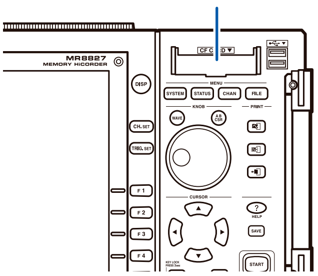
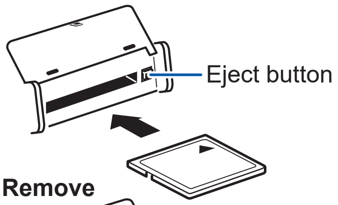
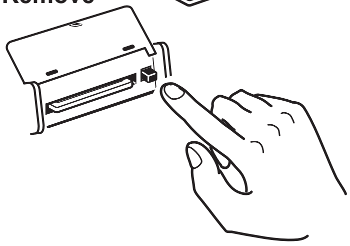
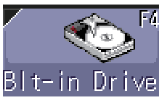
USB Memory | CF card | Built-in drive

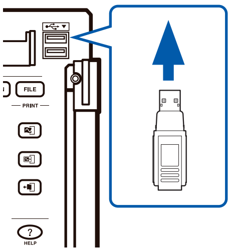
Icons indicating the status of storage media are always shown at the top of the screen.

: Media is inserted

: Media is inserted and selected as save target (Icon is red)

: Media is not inserted but is selected as save target (Icon is black)

Storage media	Insertion procedure and notes	
CF Card F1 CF Card	**To insert a CF card** With the Front mark (▲) pointing toward the slot, fully insert the card in the direction of the arrow. When the Eject button has popped out, press it down first before inserting the CF card all the way in. Inserting the CF card when the Eject button is not pressed down may cause damage to the instrument. If the CF card cannot go all the way in, do not force it in. Press the Eject button so it pops out, then press it down again before fully inserting in the CF card. **To remove a CF card** Press the Eject button. Press the Eject button. When the button pops out, press it again to eject the CF card.	**Front side**  **Insert**  **Remove** 
Built-in drive F4 Blt-in Drive	Model U8330 SSD Unit (capacity: 128 GB, 1 GB=1,000,000,000 bytes) The optional Model U8330 SSD Unit (factory option) is required. The hard disk is formatted at the factory.	
RAM (Internal memory) F3 Memory (INT)	• Memory integrated in the unit is used. Only settings files can be saved. • Automatic saving of data is not possible.	

Storage media	Insertion procedure and notes
USB Memory USB Stick	• Do not connect any devices other than USB memory sticks. • Not all commonly available USB memory sticks are supported. • To use a USB memory stick, suitable unit settings must be made, as described next page. **To insert a USB memory stick** Ensure correct orientation of the USB memory stick and push it all the way into the connector. **To remove a USB memory stick** Verify that the instrument is not accessing the USB memory stick (for saving or loading data, etc.). Then pull the USB memory stick out. (No special steps are required on the instrument.) **Front side**  **USB Connector (Type A)**

Depending on the intended use of the USB memory stick, connector types and settings on the instrument will differ.

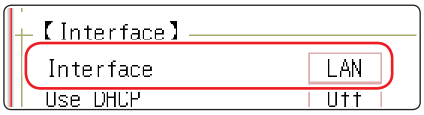
USB use	Connector	Instrument settings		Reference information
		Interface	USB setting	
USB memory stick	Type A	LAN	USB Memory	See procedure below
To retrieve CF card or built-in drive files from a computer (PC) (using a USB cable)	Type B	LAN	Mass storage HDD, mass storage CF	“16.4” (p. 334)
For communication with a PC (using a USB cable)	Type B	USB	Interface	“16.6.1” (p. 336)

> Even when the built-in drive is SSD, it is recognized as HDD.

Procedure

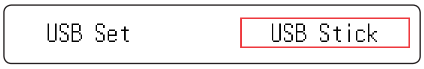
Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.

1 **Move the cursor to [Interface], and select [LAN].**



【Interface】
Interface LAN
Use DHCP Off

2 **Move the cursor to [USB Set], and select [USB Stick].**



USB Set USB Stick

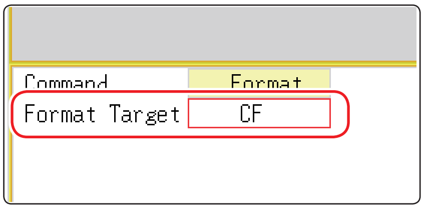
2.3.2 To Format Storage Media

Possible targets for formatting are CF card, USB memory stick, built-in drive, and internal memory. During the formatting process, a folder named “HIOKI_MR8827” will be created.

> Note that formatting storage media deletes all the information on the storage media and deleted information is unrecoverable.

Procedure

Press the **FILE** key to open the File screen.



Command: Format

Format Target: CF

1. **Insert the storage media.**
2. **Select [Next Page].**

   Select **[Format]**.

   The cursor moves to the **[Format Target]** item.
3. **Select the storage media to format, and select [Exec].**

   The specified storage media will be formatted.

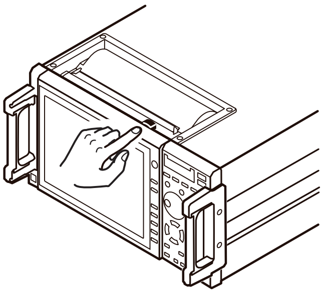
   A confirmation window will be displayed. Select **[Yes]** to proceed, or **[No]** to cancel.

2.4 Load Instrument With Recording Paper (When Model U8350 Printer Unit is installed)

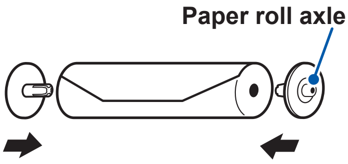
Read “Handling the Printer and Recording Paper” (p. 10) carefully.

Procedure

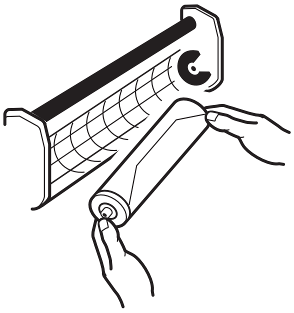
Required items: Model MR9231 Recording Paper, Paper roll axle (Supplied with the instrument)



1 **Press the button to open the printer cover.**



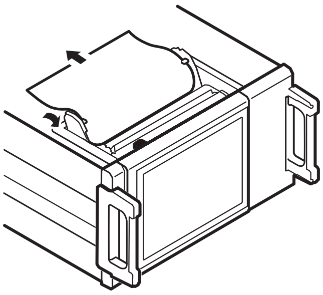
2 **Insert the paper roll axles into the core of Model 9321 Recording Paper.**



3 **Load the instrument with the paper, putting it into the holder.**

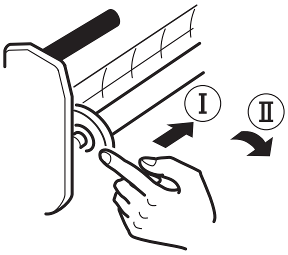
Put the right side of the paper first into the holder, and then press its left side until it clicks, pressing it rightward.

> Face the print side of the paper frontward. Putting the paper in the holder without the paper roll axle installed will make the printer cover impossible to be opened, resulting in damage to the printer.



4 **Pull out the edge of the paper toward the other side, and close the printer cover, pressing the edge face of the paper against the cover’s side surface.**

> The surface of the paper may become sticky from the residue left behind by the adhesive tape and cause the printing on that area to become unreadable. Unroll approximately the first 200 mm of paper before inserting it into the printer.



How to withdraw the recording paper

As shown in the left figure, withdraw the paper, pressing the paper roll axle rightward.

2.5 Power Supply

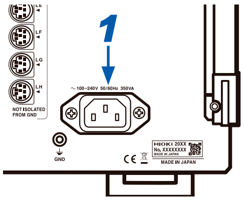
Read “Before Turning the Power Supply On” (p. 13) carefully.

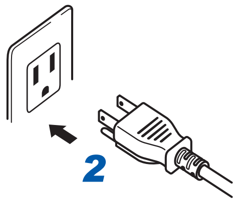
2.5.1 Connect the Power Cord

Procedure

1. **Connect the power cord to the power inlet on the instrument.**
2. **Plug the power cord into the mains outlet.**

Back side



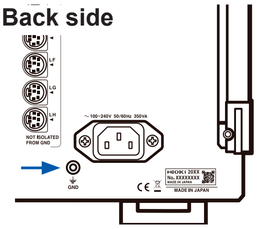


2.5.2 Ground the Functional Earth of This Instrument

When measuring in a noisy environment, you can improve the noise immunity by connecting the GND terminal (functional earth terminal).

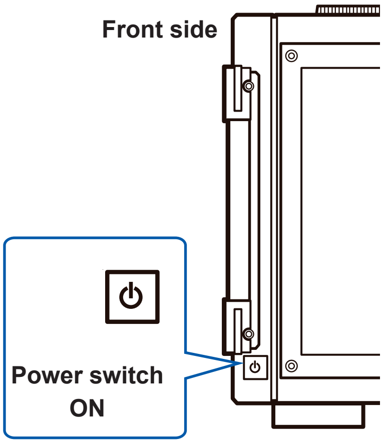
When using a potential transformer (PT) for AC power line measurements or similar, the GND terminal of the PT must also be grounded.

Back side



2.5.3 Turn the Power On and Off

Turn Power On



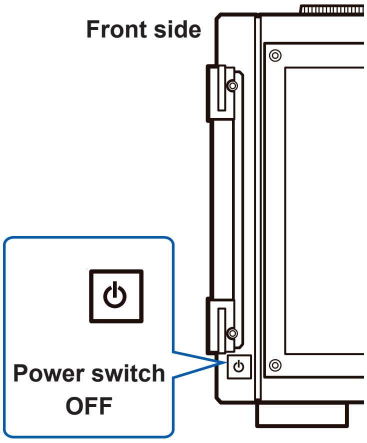
Press the power switch.

The startup screen appears first, then the Waveform screen is displayed.

Before Starting Measurement
To obtain precise measurements, allow about 30 minutes for warm-up after turning power on to allow the internal temperature of the modules to stabilize. After warm-up, perform zero adjustment before taking measurements.

Turn Power Off

Before Turning Power Off
When the power switch is turned off, data recorded in the internal memory is erased. If you do not want to lose recorded data, save it first to a CF card or external storage media.
Refer to “5 Save/Load Data and Manage Files” (p. 83).



Press the power switch.

The instrument is turned off.
When power is turned on again, the display appears with the same settings as when power was last turned off.
When the auto-setup function is enabled, settings will be loaded and established automatically. (p. 102)

2.6 Set the Clock

Set date and time for the built-in clock as follows.
The clock has an automatic calendar with leap year correction and 24-hour format.
The functions listed below make use of the clock. Ensure that the clock is set correctly before using these functions.

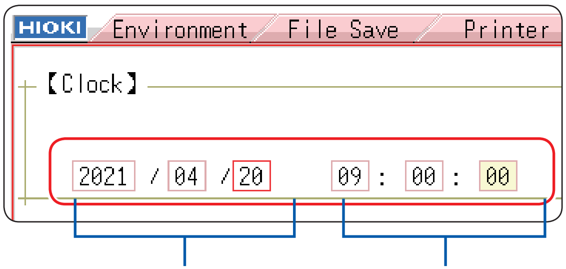
- Measurement with timer-based trigger
- Printout of data including count of trigger events
- Saving measurement data

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[init]** sheet.

1 **Move the cursor to the [Clock] item.**

2 **Select the digit to change and set the numeric value.**



【Clock】

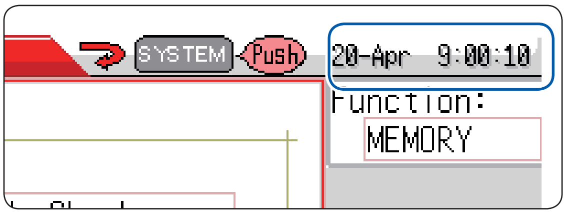
2021 / 04 / 20 09 : 00 : 00

Date setting
(Year, Month, Day)

Time setting
(Hour, Minutes, Seconds)

3 **Select [Apply] while the cursor is on one of the [Clock] items**

The clock is set to the current date and time values.
The date and time indication is shown at the top right of the screen.



20-Apr 9:00:10

Function:
MEMORY

2.7 Adjust the Zero Position (Zero-Adjust)

This procedure compensates for module differences and sets the reference potential of the instrument to 0 V.
The compensation procedure is performed for all channels and ranges.

Before Performing Zero-Adjust

- Before performing this procedure, allow the equipment to warm up for about 30 minutes after the power is turned on so the internal temperature of the modules can stabilize.
- Note that zero-adjust cannot be performed during measurement.
- Key operations are not accepted during zero-adjust.
- The time required for zero-adjust varies depending on the type and number of modules installed in the instrument. (The procedure may take several seconds.)

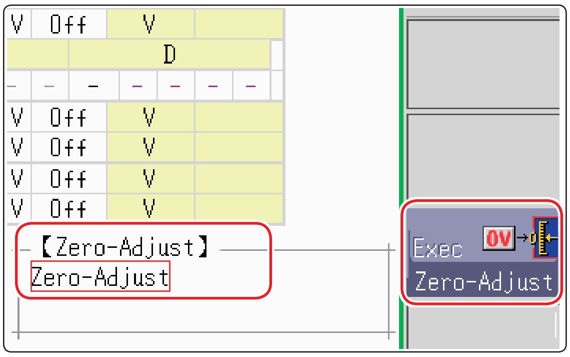
Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Unit List]** sheet.

1 **Move the cursor to [Zero-Adjust].**

2 **Select [Exec Zero-Adjust].**

The zero-adjust procedure is carried out.



Zero-adjustment has no effect on the 8969 and U8969 Strain Unit.
(Perform zero-adjust using auto-balance. (p. 174))

Perform zero-adjust in the following cases.

- When a module was changed.
- When power was turned off and on again.
- When settings were initialized (system reset).
- When DC/RMS is switched at the 8971 Current Unit and the 8972 DC/RMS Unit
- When measurement mode has been switched on Model U8979 Charge Unit
- When the ambient temperature has changed significantly.
  Zero-position drift* may occur.

* Drift:
This refers to spurious output caused by a shift in the operating point of an operational amplifier. Drift can occur due to changes in temperature and due to component aging over a period of use.

2.8 Perform Calibration (When Model MR8990 is installed)

This procedure compensates for MR8990 Digital Voltmeter Unit differences.
The compensation procedure is performed for all channels and ranges.

Before Performing Calibration

- Before performing this procedure, allow the equipment to warm up for about 30 minutes after the power is turned on so the internal temperature of the modules can stabilize.
- Note that calibration cannot be performed during measurement. However, if the calibration setting is set to ON, calibration is performed at the start of measurement.
- Key operations are not accepted during calibration.
- The time required for calibration varies depending on the type and number of modules installed in the instrument. (The procedure may take several seconds.)

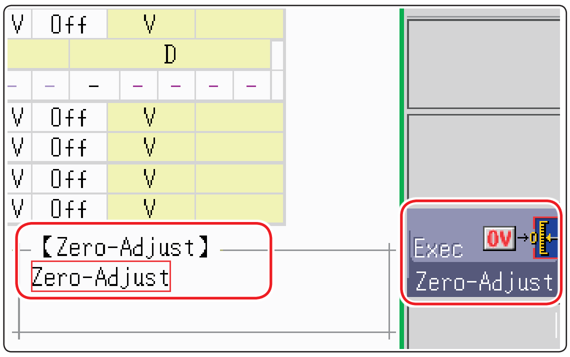
Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Unit List]** sheet.

1 **Move the cursor to [Zero-Adjust].**

2 **Select [Exec Zero-Adjust].**

Calibration will be performed.



In the following cases, calibration should be executed again.

- When a module was changed.
- When power was turned off and on again.
- When settings were initialized (system reset).
- When the ambient temperature has changed significantly.

3 Measurement

3.1 Measurement Workflow

1 Pre-measurement Inspection

Refer to “3.2 Pre-measurement Inspection” (p. 57).

2 Basic Measurement Settings

	Refer to...
Select a suitable recording method for the measurement target	“3.3.1 Measurement Function” (p. 58)
Set sampling rate	“3.3.2 Timebase and Sampling Rate” (p. 60)
Set recording length	“3.3.3 Recording Length (Number of Divisions)” (p. 63)
Set waveform display format and printing format	“3.3.4 Screen Layout” (p. 65)

Application examples

Refer to...
“7.4 Perform Waveform X-Y Synthesis” (p. 134)
“8.2 Display Waveforms During Recording (Roll Mode)” (p. 153)
“8.3 Display New Waveforms Over Past Waveforms (Overlay)” (p. 154)
“10 Numerical Calculation Functions” (p. 217)

3 Input Channel Settings

	Refer to...
Choose analog channel settings	“3.4.2 Choose Analog Channel Settings” (p. 69)
Choose logic channel settings	“3.4.3 Logic Channel Settings” (p. 72)

Application examples

Refer to...
“8.1 Add Comments” (p. 146)
“8.5 Convert Input Values (Scaling Function)” (p. 157)
“8.6 Set the Waveform Position (Variable Function)” (p. 164)
“8.7 Fine Adjustment of Input Values (Vernier Function)” (p. 167)
“8.8 Invert the Waveform (Invert Function)” (p. 168)

4 Trigger Settings

Refer to “9 Trigger Settings” (p. 195).

5 Start Measurement

Refer to...
“3.5 Start and Stop Measurement” (p. 74)
“5 Save/Load Data and Manage Files” (p. 83)
“6 Printing (When Model U8350 Printer Unit is installed)” (p. 113)
“7.1 Read Measurement Values (Using the AB Cursors)” (p. 128)
“7.3.2 Scroll With Jog and Shuttle Knobs (Scroll)” (p. 132)
“7.5 Magnify and Compress Waveforms” (p. 136)

6 Stop Measurement

Refer to “3.5 Start and Stop Measurement” (p. 74).

To check the input signal

Press the **AUTO** key. Input waveform timebase and vertical axis (voltage axis) range will be selected, zero-adjust performed and measurement started, all automatically.

“3.6 Measurement With Automatic Range Setting (Auto-ranging Function)” (p. 76)

To reuse previously stored settings

Load the settings file from the File screen.
Saving the settings for different measurement targets or applications makes operation more convenient.

Refer to “5.3 Load Data” (p. 99).

To automatically restore previous settings at power-up

Stored measurement settings can be automatically loaded from a file when the unit is turned on. Simply insert a CF card with an auto-settings file before turning the unit on.

Refer to “5.4 Automatically Load Settings (Auto-setup Function)” (p. 102).

Make sure that the file is stored in the “HIOKI_MR8827” folder of the CF card.

To return settings to their original (basic default) state

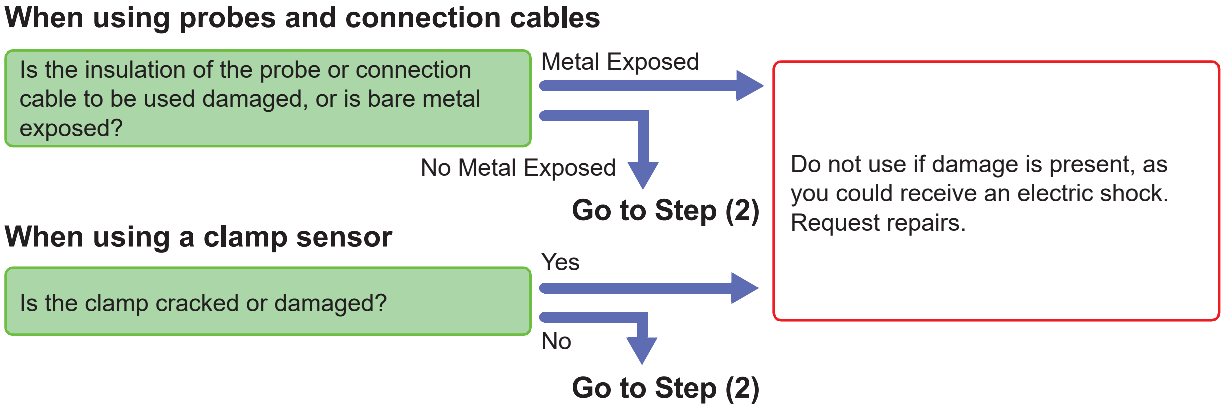
From the System screen, select the **[Init]** sheet to return the unit to the factory default settings.
In this condition, the unit is set up to easily perform simple measurements.
If operation of the instrument seems unusual or overly complex, reinitialize the instrument.

Refer to “19.2 Reset the Instrument” (p. 402).

3.2 Pre-measurement Inspection

Verify that the instrument operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.

(1) Peripheral Device Inspection



When using probes and connection cables

Is the insulation of the probe or connection cable to be used damaged, or is bare metal exposed?

Metal Exposed → Do not use if damage is present, as you could receive an electric shock. Request repairs.

No Metal Exposed → **Go to Step (2)**

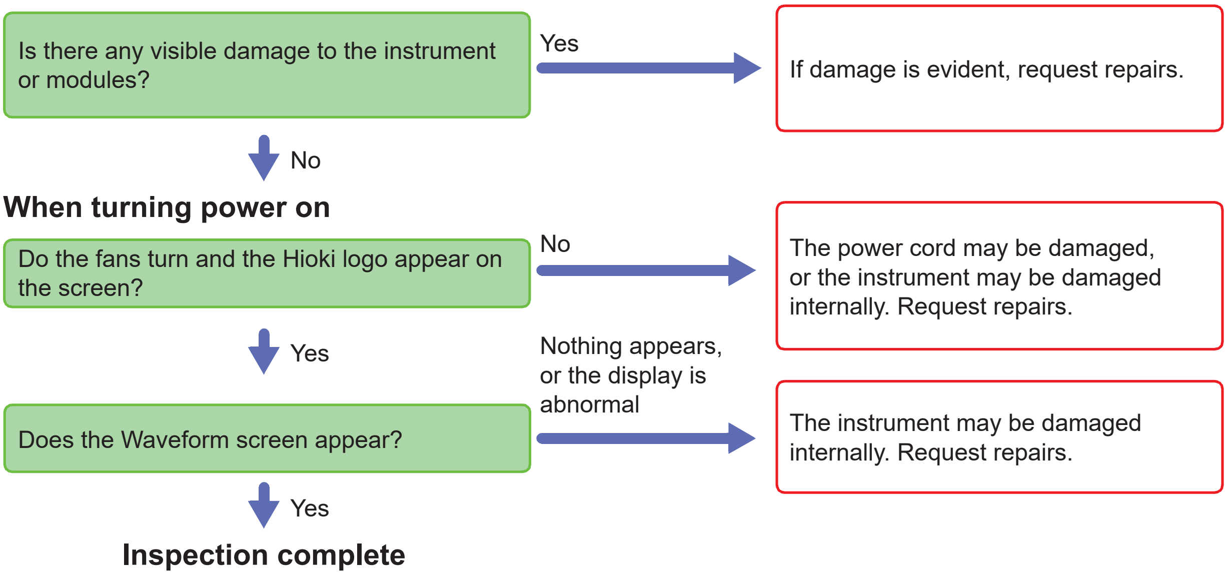
When using a clamp sensor

Is the clamp cracked or damaged?

Yes → Do not use if damage is present, as you could receive an electric shock. Request repairs.

No → **Go to Step (2)**

(2) Instrument and Module Inspection



Is there any visible damage to the instrument or modules?

Yes → If damage is evident, request repairs.

No ↓

When turning power on

Do the fans turn and the Hioki logo appear on the screen?

No → The power cord may be damaged, or the instrument may be damaged internally. Request repairs.

Yes ↓

Does the Waveform screen appear?

Nothing appears, or the display is abnormal → The instrument may be damaged internally. Request repairs.

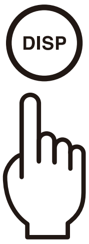
Yes ↓

Inspection complete

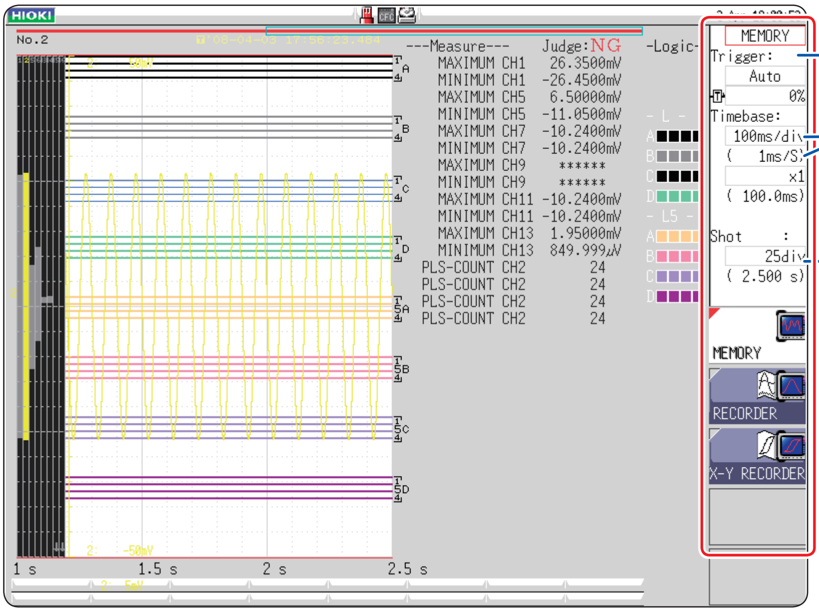
3.3 Measurement Configuration

Set measurement conditions as follows.
You can immediately verify the effect of settings on the waveform by calling up the Waveform screen and using the Settings window to make basic settings. Basic settings can also be made by calling up the Status screen and selecting the **[Status]** sheet.

Open the Settings Window



Press this key.



```
---Measure---      Judge:NG
  MAXIMUM CH1   26.3500mV
  MINIMUM CH1  -26.4500mV
  MAXIMUM CH5   6.50000mV
  MINIMUM CH5  -11.0500mV
  MAXIMUM CH7  -10.2400mV
  MINIMUM CH7  -10.2400mV
  MAXIMUM CH9    ******
  MINIMUM CH9    ******
  MAXIMUM CH11 -10.2400mV
  MINIMUM CH11 -10.2400mV
  MAXIMUM CH13  1.95000mV
  MINIMUM CH13  849.999µV
PLS-COUNT CH2       24
PLS-COUNT CH2       24
PLS-COUNT CH2       24
PLS-COUNT CH2       24
```

```
MEMORY
Trigger:
   Auto
        0%
Timebase:
  100ms/div
 (   1ms/S)
         x1
 ( 100.0ms)
Shot     :
     25div
 ( 2.500 s)
```

"Settings window"

"Trigger" (p. 58)

"Timebase setting (Sampling rate)" (p. 60)

"Recording Length (Number of divisions)" (p. 63)

3.3.1 Measurement Function

Select the function according to the target and type of measurement.

Procedure

Press the **DISP** key to open the Waveform screen.

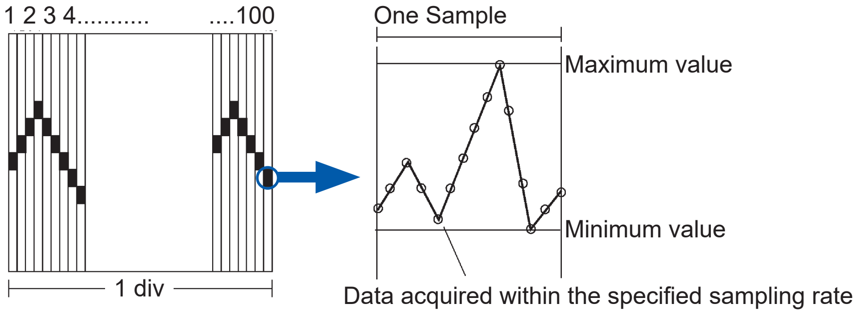
Move the cursor to the function item (the upper most column of the Settings window).

MEMORY (*Default setting*)/
RECORDER/ X-Y RECORDER/ FFT

MEMORY	**Measure an instantaneous waveform or a transient phenomenon.** Trigger and calculation functions can be used.
RECORDER	**Record the variation and monitoring data of a slow phenomenon.** Data can be printed in real time.
X-Y RECORDER	**An endless X-Y waveform can be displayed.** Pen up/down operation as in an X-Y pen recorder is possible. Refer to "4 X-Y Recorder Function" (p. 77).
FFT	**Analyze the frequency.** **Perform various types of spectrum and octave analysis.** Refer to "13 FFT Function" (p. 251).

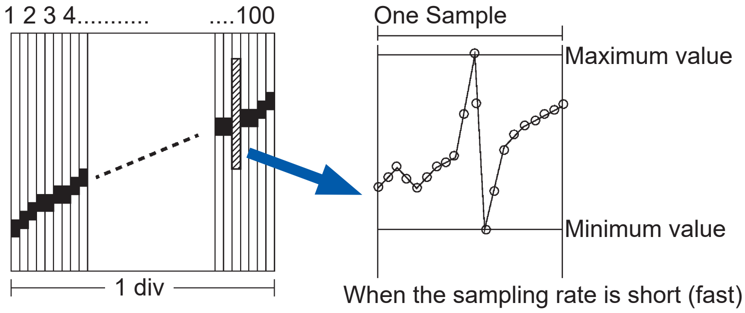
Recorder Function Values

With the Recorder function, each data sample consists of the maximum and minimum values acquired in the specified sampling rate. This means that each data sample has its own amplitude breadth.



Data acquired within the specified sampling rate

When input waveform variation is slight, the difference between maximum and minimum values can be inordinately large if the sampling rate is short and severe fluctuations are present due to noise.
This may be prevented by setting a longer sampling rate.



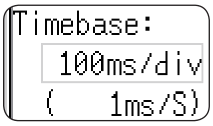
When the sampling rate is short (fast)

3.3.2 Timebase and Sampling Rate

MEM REC

The timebase setting establishes the rate of input signal waveform acquisition, specified as time-per-division on the horizontal axis (time/div).
The sampling setting specifies the interval from one sample to the next.

(The sampling rate is shown in brackets under the timebase for the Memory function (see illustration at right). The displayed sampling rate changes as the time axis range changes.)



```
Timebase:
 100ms/div
 (   1ms/S)
```

Procedure

Press the **DISP** key to open the Waveform screen.

With the Memory Function

1 **Move the cursor to the [Timebase] item.**

2 **Set the time per division on the horizontal axis (time axis).**

5 (*Default setting*), 10, 20, 50, 100, 200, 500 μs/div
1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div
1, 2, 5, 10, 30, 50 s/div, 1 min/div, 100 s/div
2, 5 min/div

To control sampling with an external signal, select **[External]** and input the signal from the external sampling terminal. To reset the setting to the internal sampling, select **[Internal]** and set the time.
When external sampling is selected, the number of samples per division can be set in the range from 10 - 1000 S/div.
"17.2.3 External Sampling (EXT.SMPL)" (p. 350).

With the Recorder Function

1 **Move the cursor to the [Timebase] item.**

2 **Set the time per division on the horizontal axis (time axis).**

10 (*Default setting*), 20, 50, 100, 200, 500 ms/div
1, 2, 5, 10, 30, 50 s/div, 1 min/div, 100 s/div
2, 5, 10, 30 min/div, 1 h/div

3 **Move the cursor to the [Sampling] item.**

4 **Set the sampling rate.**

1 (*Default setting*), 10, 100 μs
1, 10, 100 ms
(Select a sampling rate less than 1/100 of the time base)

The range of choices depends on the selected timebase.
The higher the sampling rate, the more detailed the changes that can be observed.

MEM

To select the timebase

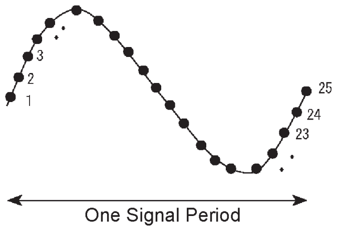
Refer to the table below when setting the timebase.
For example, to measure a 100 kHz waveform, the maximum display frequency setting range according to the table is 200 kHz - 800 kHz. If the maximum display frequency is set to 400 kHz, setting the time axis range to 10 μs/div is recommended.

Timebase	Sampling rate (Speed)	Maximum display frequency
5 μs/div	50 ns (20 MS/s)	800 kHz
10 μs/div	100 ns (10 MS/s)	400 kHz
20 μs/div	200 ns (5 MS/s)	200 kHz
50 μs/div	500 ns (2 MS/s)	80 kHz
100 μs/div	1 μs (1 MS/s)	40 kHz
200 μs/div	2 μs (500 kS/s)	20 kHz
500 μs/div	5 μs (200 kS/s)	8 kHz
1 ms/div	10 μs (100 kS/s)	4 kHz
2 ms/div	20 μs (50 kS/s)	2 kHz
5 ms/div	50 μs (20 kS/s)	800 Hz
10 ms/div	100 μs (10 kS/s)	400 Hz
20 ms/div	200 μs (5 kS/s)	200 Hz
50 ms/div	500 μs (2 kS/s)	80 Hz
100 ms/div	1 ms (1 kS/s)	40 Hz
200 ms/div	2 ms (500 S/s)	20 Hz
500 ms/div	5 ms (200 S/s)	8 Hz
1 s/div	10 ms (100 S/s)	4 Hz
2 s/div	20 ms (50 S/s)	2 Hz
5 s/div	50 ms (20 S/s)	0.8 Hz
10 s/div	100 ms (10 S/s)	0.4 Hz
30 s/div	300 ms (3.33 S/s)	0.13 Hz
50 s/div	500 ms (2 S/s)	0.08 Hz
1 min/div	600 ms (1.67 S/s)	0.04 Hz
100 s/div	1 s (1 S/s)	0.067 Hz
2 min/div	1.2 s (0.83 S/s)	0.033 Hz
5 min/div	3 s (0.33 S/s)	0.013 Hz

S/s = Number of samplings / second

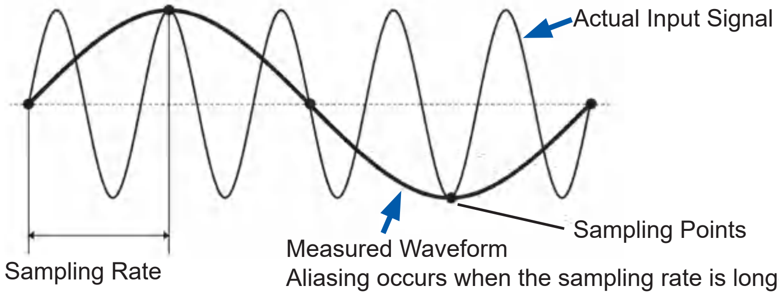
What is the maximum display frequency?

Displaying waveforms by their sampled values with adequate resolution of characteristics such as sine wave peaks requires a minimum of about 25 samples per waveform period.
Maximum display frequency is determined by the timebase.



What is aliasing (recording of non-existent waveforms)?

If the signal to be measured changes too fast relative to the sampling rate, beginning at a certain frequency, non-existent slow signal fluctuations are recorded. This phenomena is aliasing.



Aliasing occurs when the sampling rate is longer than half of the input signal period.

With the Memory function, the sampling rate can be significantly affected by the timebase setting, so care is necessary to avoid aliasing when selecting the timebase. Because the timebase determines the maximum display frequency, the fastest possible timebase setting should be used.
When the signal can be recorded repeatedly, the auto-ranging function (p. 76) may be used to select the optimum timebase.

The sampling rate is automatically set to 1/100 of the selected timebase.

If MR8990 Digital Voltmeter Unit is installed, that channel's sampling rate is automatically set to 1/50 of the selected timebase.

Example: When 8966 is installed as unit 1 (CH1 and CH2) and MR8990 as unit 2 (CH3 and CH4), and the timebase is set to 1 s/div
Sampling rate of unit 1 (8966): 10 ms
Sampling rate of unit 2 (MR8990): 20 ms

To automatically set the timebase

When you press the **AUTO** key, a suitable timebase for the input signal is selected and measurement starts. (This applies only to the Memory Function.)
Refer to “3.6 Measurement With Automatic Range Setting (Auto-ranging Function)” (p. 76).

REC

- The timebase and sampling rate can be set independently. The sampling rate is selected depending on the timebase setting.
- When the following timebase values are selected, displayed waveforms are compressed in the horizontal (time axis) direction as shown.
  20 ms/div → ×1/2,
  10 ms/div → ×1/5

To minimize noise during measurement

If the sampling rate is too fast and the input waveform amplitude is small, the difference between maximum and minimum values may become quite large as a result of sudden fluctuations, such as those caused by noise. To prevent this, select a slower sampling rate or enable the module's lowpass filter (p. 69).

MEM **REC** Common

The data refresh rate is not allowed to exceed the maximum sampling rate of the module.
During the period when data is not updated, the same data is measured, resulting in a stair-shaped waveform.
Even when the same signal is sampled simultaneously by two modules, the data may differ due to differences in sampling rate, frequency bandwidth, and frequency response.

Data refresh rate for various modules

Module	Max. timebase	Max. sampling rate or data refresh rate	Reference
Model 8966	5 µs/div	50 ns (20 MS/s)	-
Model 8967	Dependent on data refresh setting	Dependent on data refresh setting	Refer to “8.10.3” (p. 173).
Model 8968	100 µs/div	1 µs (1 MS/s)	-
Model 8969 Model U8969 Model U8979	500 µs/div	5 µs (200 kS/s)	-
Model 8970	Dependent on setting	Dependent on setting	Refer to “8.10.5” (p. 175).
Model 8971	100 µs/div	1 µs (1 MS/s)	Refer to “8.10.6” (p. 178).
Model 8972	Dependent on response setting	Dependent on response setting	Refer to “8.10.7” (p. 178).
Model 8973	5 µs/div	50 ns (20 MS/s)	-
Model MR8990	Dependent on NPLC setting	Dependent on NPLC setting	-
Model U8974	100 µs/div	Depends on response setting	Refer to “8.10.9” (p. 180).

3.3.3 Recording Length (Number of Divisions) MEM REC

Set the length (number of divisions) to record each time data is acquired.

Procedure

Press the **DISP** key to open the Waveform screen.

With the Memory Function

1 **Move the cursor to [Shot].**

2 **Select the type.**

Fixed Shot	Select from a range of preset values.
User Shot	Freely specify any value in 1-division units.

3 **Set the recording length.**

(Fixed Shot)

25, 50, 100, 200, 500, 1,000, 2,000, 5,000, 10,000, 20,000, 50,000, 100,000 div
200,000 div (in 4/8/16 ch mode)
500,000 div (in 4/8 ch mode)
1,000,000 div (in 4 ch mode)

(User Shot)

1 to 160,000 div (in 32 ch mode)
1 to 320,000 div (in 16 ch mode)
1 to 640,000 div (in 8 ch mode)
1 to 1,280,000 div (in 4 ch mode)

With the Recorder Function

1 **Move the cursor to [Shot].**

2 **Select the type.**

Fixed Shot	Select from a range of preset values.
User Shot	Freely specify any value in 1-division units.

3 **Set the recording length.**

(Fixed Shot)

Cont. On-Off	When **[On]** is selected, measurement is carried out while continuously overwriting the data in memory. Data from the point at which measurement was stopped back to the maximum recording length can be saved or printed.

25, 50, 100, 200, 500, 1,000, 2,000, 5,000, 10,000, 20,000, 50,000 div

(User Shot)

1 to 80,000 div

MEM

Recording Length and Data Samples

Each division of the recording length consists of 100 data samples. The total number of data samples for a specified recording length is: Set recording length (divisions) × 100 + 1.
However, if the MR8990 Digital Voltmeter Unit is installed, the number of data samples is as follows.

- When only MR8990 is installed
  Number of data samples for each division: 50 data samples
  Total number of data samples for recording length: Set recording length (divisions) × 50 + 1

- When a mix of MR8990 and other modules are installed
  Channels for MR8990 units
    Number of data samples for each division: 50 data samples
    Total number of data samples for recording length: Set recording length (divisions) × 50 + 1
  Channels for other modules
    Number of data samples for each division: 100 data samples
    Total number of data samples for recording length: Set recording length (divisions) × 100 + 2

REC

Each recording length division consists of 100 pairs of data points, with each pair composed of two values: the maximum and minimum measured values within each sampling period. The MR8990 data measured by the recorder function has a resolution of 16 bits.

When recording length is set to [Cont.]

- The instrument stores the maximum recording length of data back from the point at which measurement was stopped in its internal memory (80,000 divisions).
- For range settings of 10 ms/div to 200 ms/div, when the printer setting (real-time print) is On, the real-time print is not performed. Perform printing manually after measurement is completed. (p. 118)
- When Auto-saving is On, the saving is not performed during the measurement. When measurement is stopped, the data currently stored in the internal memory is saved.

When recording length is changed during measurement

Measurement data already stored in memory is discarded and measurement starts with the newly set recording length.

3.3.4 Screen Layout

MEM **REC** **X–Y**

You can specify the format in which the input signal is shown on the Waveform screen.
This setting will also affect how the waveform will be printed.

> Selecting X-Y1 screen or X-Y4 screen allows waveform X-Y synthesis.
> (This applies to the Memory and X-Y Recorder functions.)
> Refer to “7.4 Perform Waveform X-Y Synthesis” (p. 134).

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet

With the Memory Function

Move the cursor to [Format].

Single	Display and record using 1 graph. (*Default setting*)
Dual	Display and record using 2 graphs.
Quad	Display and record using 4 graphs.
Oct	Display and record using 8 graphs.
Hex	Display and record using 16 graphs.
X-Y Single	Set input signal to X-Y and display and record the correlation using 1 graph.
X-Y Quad	Set input signal to X-Y and display and record the correlation using 4 graph.

With the Recorder Function

Move the cursor to [Format].

Single	Display and record using 1 graph. (*Default setting*)
Dual	Display and record using 2 graphs.
Quad	Display and record using 4 graphs.
Oct	Display and record using 8 graphs.
Hex	Display and record using 16 graphs.

Analog Channel Assignment

With 2, 4, 8 or 16 screens, analog channels can be freely assigned to the different graphs.

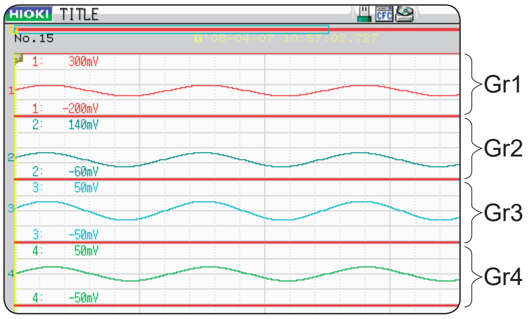
Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Unit List]** sheet.

1. **Move the cursor to [Graph].**
2. **Select the display screen for each channel.**

   The graphs are numbered Gr1, Gr2, Gr3, etc. starting from the top.

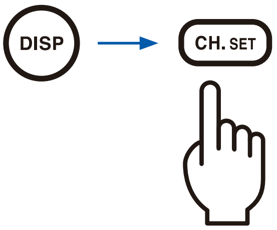
<Sample screen after assigning channels>



3.4 Select Input Channels

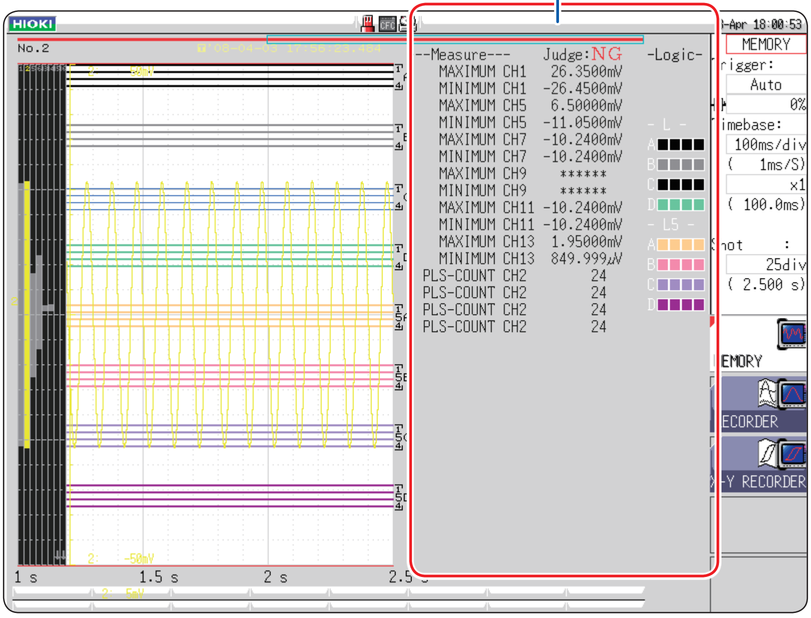
Set which channels are analog and logic.

To Open the Channel Settings Window



Pressing **CH.SET** repeatedly cycles through the available sheets.

[Analog]
↓
[Variable]
↓
[Logic]
↓
[WaveCalc] (When [Wave Calculation] is [On])
or
[Generator] (When a waveform generator module is installed)
↓
No display


Refer to “Variable Function Settings for All Channels” (p. 166).

```
--Measure---     Judge:NG
  MAXIMUM CH1    26.3500mV
  MINIMUM CH1   -26.4500mV
  MAXIMUM CH5    6.50000mV
  MINIMUM CH5   -11.0500mV
  MAXIMUM CH7   -10.2400mV
  MINIMUM CH7   -10.2400mV
  MAXIMUM CH9     ******
  MINIMUM CH9     ******
  MAXIMUM CH11  -10.2400mV
  MINIMUM CH11  -10.2400mV
  MAXIMUM CH13   1.95000mV
  MINIMUM CH13   849.999μV
 PLS-COUNT CH2        24
 PLS-COUNT CH2        24
 PLS-COUNT CH2        24
 PLS-COUNT CH2        24
```

If the channel setting screen is hard to see due to waveform overlap, narrow the waveform display width to divide the waveform display screen and trigger settings screen.

Refer to “7.7.3 Switch the Waveform Display Width” (p. 142).

To perform waveform interpolation

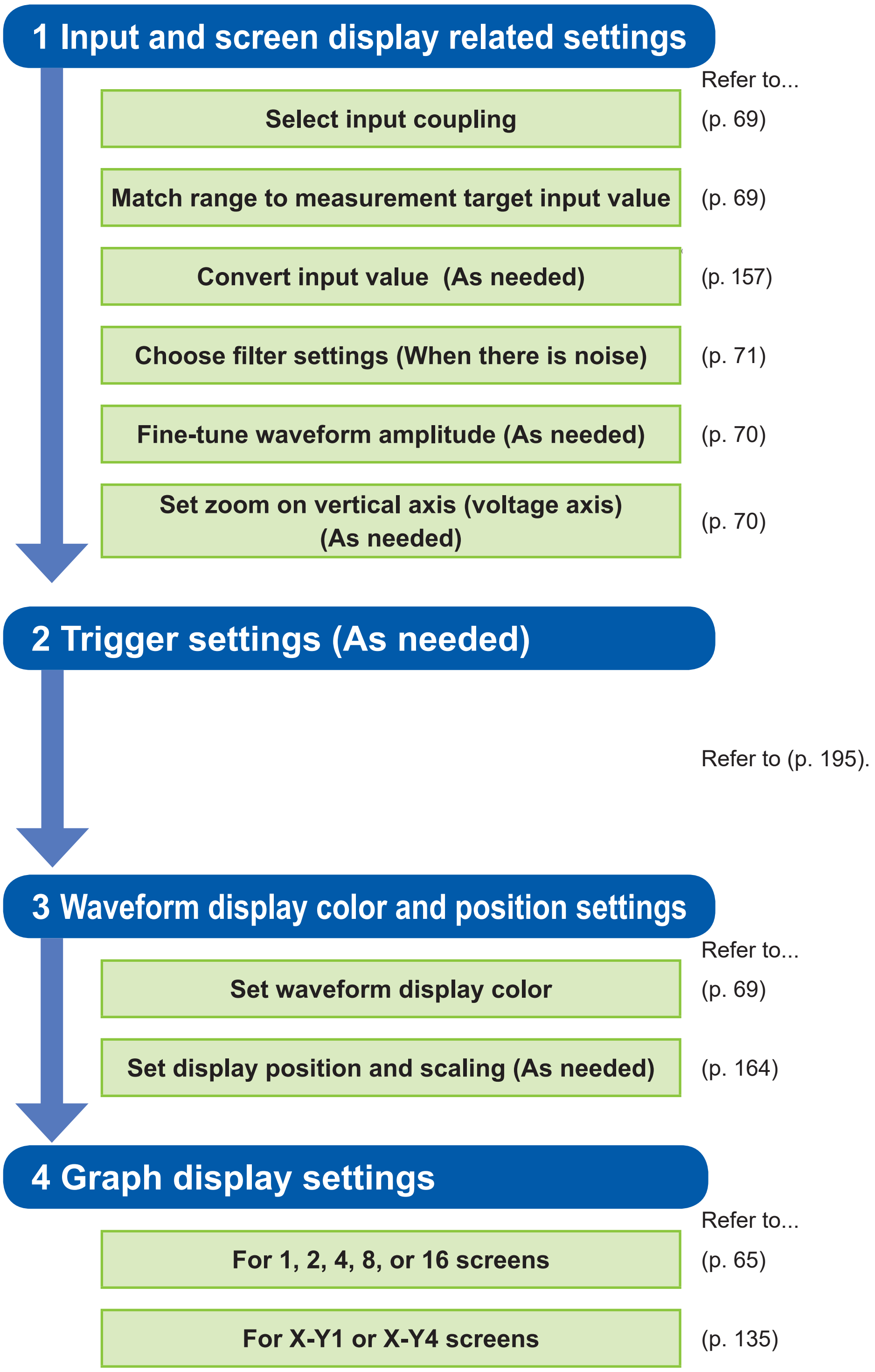
Set the waveform display color in the channel setting window to Off.
Refer to “1. Waveform Display Color” (p. 69).

To copy the settings of one channel to another

Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

3.4.1 Channel Setting Workflow

The workflow below shows how to choose settings for analog channels (CH1 to CH32).



1 Input and screen display related settings

	Refer to...
Select input coupling	(p. 69)
Match range to measurement target input value	(p. 69)
Convert input value (As needed)	(p. 157)
Choose filter settings (When there is noise)	(p. 71)
Fine-tune waveform amplitude (As needed)	(p. 70)
Set zoom on vertical axis (voltage axis) (As needed)	(p. 70)

2 Trigger settings (As needed)

Refer to (p. 195).

3 Waveform display color and position settings

	Refer to...
Set waveform display color	(p. 69)
Set display position and scaling (As needed)	(p. 164)

4 Graph display settings

	Refer to...
For 1, 2, 4, 8, or 16 screens	(p. 65)
For X-Y1 or X-Y4 screens	(p. 135)

- When input coupling is set to GND, the waveform will have no amplitude and you cannot set the range.
- Due to the influence of filter attenuation, correct range setting may not be possible.
- When choosing trigger settings, set the vertical axis (voltage axis) range first. If the range is changed after specifying the trigger, the trigger setting may change.
- When using the Variable function, set the vertical axis (voltage axis) range first. If you change the range setting after applying the variable function observation with sufficient precision may not be possible.
- When using the Variable and Scaling functions together, apply the Scaling function first. If you apply the Scaling function after the Variable function, you may not get the intended display result.

The setting workflow for logic channels (standard LOGIC terminals LA - LH, expansion LOGIC terminals L1A to L8D) is explained below.

1 Select screen display related settings

Refer to...

Set logic recording width (p. 72)

2 Waveform display color and position settings

Refer to...

Set waveform display position (p. 72)

Set waveform display color (p. 72)

- Waveform display position can be specified in 1% increments.
- Not displayed for X-Y1 and X-Y4 screens.
- Up to two logic units can be installed as units 1 to 8. Logic units installed in other positions cannot be used.

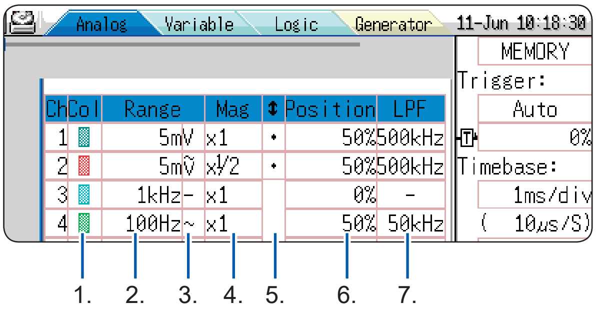
3.4.2 Choose Analog Channel Settings

For information about specific settings for each module, refer to “8.10 Detailed Settings for Modules” (p. 170).

Procedure

Press the **DISP** key to open the Waveform screen, and the press the **CH.SET** key to open the channel settings window (**[Analog]** sheet)

1. **Move the cursor to the channel for which you want to change the settings.**
2. **Select settings with the F keys.**



Ch	Col	Range		Mag	⇕	Position	LPF
1	▨	5m	V	x1	•	50%	500kHz
2	▨	5m	Ṽ	x1/2	•	50%	500kHz
3	▨	1kHz	-	x1		0%	-
4	▨	100Hz	~	x1		50%	50kHz

MEMORY
Trigger:
Auto
T 0%
Timebase:
1ms/div
(10µs/S)

To copy the setting to another channel

Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

1. Waveform Display Color

Specifies the color in which the waveform of the selected channel is displayed. You can also select the same color as other channels.

Off	The waveform is not displayed. If the auto-save setting for **[Save Channel]** is **[Disp Ch]**, data for this channel will not be saved. Refer to “Select the channels to save.” (p. 90).
On	The waveform is displayed. Select the display color with the **F** keys **[↑]**, **[↓]**.
All On-Off	Switches the waveform display of all channels to all On or all OFF

2. Vertical Axis (Voltage Axis) Range

Sets the vertical axis (voltage axis) range for each channel. The value set here is the voltage of one increment on the vertical axis.
For information on the full-scale value for various modules, refer to the table in the section “6. Zero Position” (p. 70).
When the Variable function is **[On]** but variable auto-adjustment is **[Off]**, the size of the waveform on the screen will not change even if the vertical axis (voltage) range is changed.

Full-scale value = Vertical axis (voltage axis) range × 20 div

Example: If the vertical axis (voltage axis) is 1 V/div
1 V/div × 20 = 20 V
The full-scale value will be 20 V, and the measurable range will be ±20 V.

When an over-range condition has occurred

Change the vertical axis (voltage axis) range to a lower sensitivity setting.

3. Coupling

Set the input signal coupling method. Normally, DC coupling should be selected.

DC (V, –)	Both DC components and AC components of the input signal will be measured. (*Default setting*)
AC (Ṽ , ~)	Only AC components of the input signal will be measured. DC components will be blocked.
GND (⏚)	Input is shorted to ground. (Allows checking the zero position.)

4. Vertical Axis (Voltage Axis) Zoom

Vertical axis (voltage axis) zoom-up or zoom-down settings can be selected separately for each channel. These settings will be used for display and printout.
Zoom is based on the zero position. The measurement resolution does not change.
Refer to "7.5.3 Vertical Axis (Voltage Axis) Magnification" (p. 138).

Use the Variable function for user-specified zoom.
The waveform can be inverted by reversing plus/minus.
Refer to "8.6 Set the Waveform Position (Variable Function)" (p. 164).
Refer to "8.8 Invert the Waveform (Invert Function)" (p. 168).

5. Vernier

Fine adjustment of input voltage can be performed arbitrarily on the Waveform screen (display only).
When recording physical values such as noise, temperature and acceleration using sensors, amplitude can be adjusted to facilitate calibration.
Refer to "8.7 Fine Adjustment of Input Values (Vernier Function)" (p. 167).

6. Zero Position

Sets the 0 V level display position. If the 0 V input level has shifted, perform zero-adjust.
Refer to "2.7 Adjust the Zero Position (Zero-Adjust)" (p. 53).
Refer to "2.8 Perform Calibration (When Model MR8990 is installed)" (p. 54).

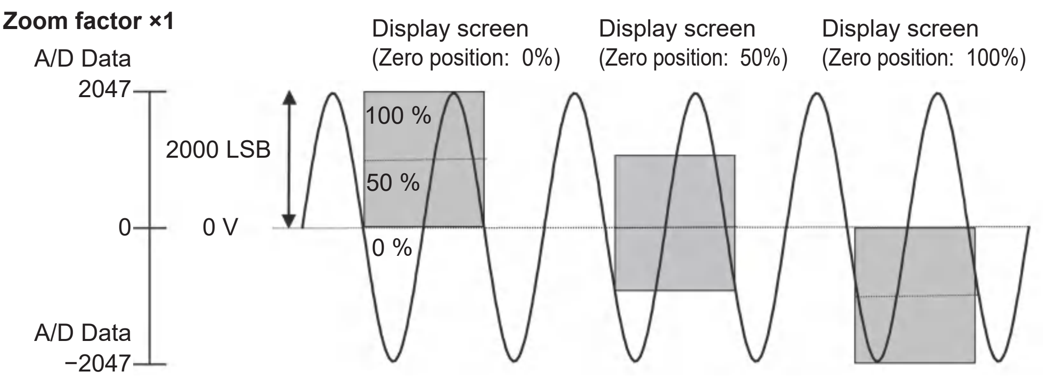
The zero position of all channels can be changed at the same time using the zero position preset (press **[Preset]**).

Ascending (3%→96%)	The zero position of CH1 is set to 3% and the following channels up to CH32 are increased by 3% each.
Descending (96%→3%)	The zero position of CH1 is set to 96% and the following channels up to CH32 are decreased by 3% each.
All Ch 0%	The zero position of all channels is set to 0%.
All Ch 50%	The zero position of all channels is set to 50%.

If the zero position of the waveform obtained with Model 8969 or U8969 Strain Unit is displaced, perform the auto-balance.
Refer to "8.10.4 Setting Model 8969 and U8969 Strain Unit" (p. 174).

- Only the display position is shifted. No offset is applied to the input.
- Vertical axis (voltage axis) zooming is based on the zero position.
- Zero position adjustment and vertical axis (voltage axis) zooming only change the voltage range as displayed on the Waveform screen. The actual measurement range does not change.

The zero position is as shown in the illustration below. (Example: 8966 Analog Unit)



Full-scale resolution for modules at various vertical axis zoom factors (LSB)

Module	Zoom factor									
	×1/10	×1/5	×1/2	×1	×2	×5	×10	×20	×50	×100
Model 8966 (Analog) Model 8971 (Current) Model 8972 (DC/RMS)	20000 (4000)	10000 (4000)	4000	2000	1000	400	200	100	40	20
Model 8967 (Temperature)*	200000	100000	40000	20000	10000	4000	2000	1000	400	200
Model 8968 (High resolution) Model U8974 (High voltage)	320000 (64000)	160000 (64000)	64000	32000	16000	6400	3200	1600	640	320
Model 8969 Model U8969 (Strain) Model U8979 (Charge)	250000 (64000)	125000 (64000)	50000	25000	12500	5000	2500	1250	500	250
Model 8970 (Power Frequency)	20000	10000	4000	2000	1000	400	200	100	40	20
Model 8970 (Count)	400000	200000	80000	40000	20000	8000	4000	2000	800	400
Model 8970 (Excluding power frequency and count)	100000	50000	20000	10000	5000	2000	1000	500	200	100
Model MR8990 (DVM)	1200000	1200000	1200000	1000000	500000	200000	100000	50000	20000	10000

The brackets for the zoom factor indicate valid data ranges.

*: With Model 8967 Temp Unit, the valid range differs depending on the thermocouple. For minimum resolution information, see the specifications of Model 8967 Temp Unit.

7. Low-Pass Filter

Select settings for the module's low-pass filter. This is useful for eliminating unwanted high-frequency components.

The filter type depends on the module. Choose setting according to the input characteristics.

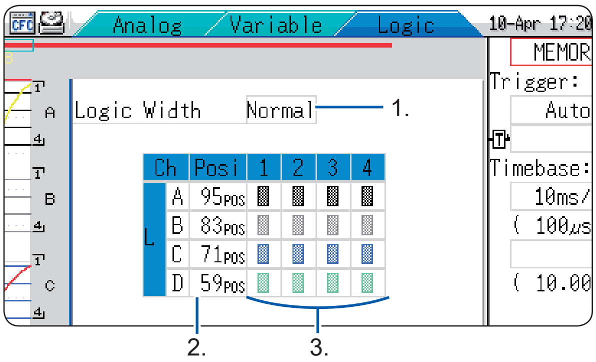
3.4.3 Logic Channel Settings

The channel settings window (Logic sheet) is shown when the display format is 1, 2, 4, 8 or 16 screens.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the channel settings window (**[Logic]** sheet).

1. **Move the cursor to the channel for which you want to change the settings.**
2. **Select settings with the F keys.**



Logic Width Normal

Ch		Posi	1	2	3	4
L	A	95POS	▨	▨	▨	▨
	B	83POS	▨	▨	▨	▨
	C	71POS	▨	▨	▨	▨
	D	59POS	▨	▨	▨	▨

To copy the setting to another channel

Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

1. Logic Width

Change the display width of the logic waveform.
Making waveforms narrower can enhance the readability of the display when there are a high number of waveforms.

Wide	Make the waveform wider.
Normal	Display the waveform at normal width.
Narrow	Make the waveform narrower. (*Default setting*)

2. Waveform Display Position

Determines where on the screen the logic waveform is displayed.
The position can be freely moved within the range of the display.

3. Waveform Display Color

Specifies the color in which the waveform of the selected channel is displayed. You can also select the same color as other channels.
For logic units, the color can be specified for each units and each channel separately.

Off	The waveform is not displayed. If the auto-save setting for **[Save Channel]** is **[Disp Ch]**, data for this channel will not be saved. Refer to “Select the channels to save.” (p. 90).
On	The waveform is displayed. Select the color with the **F** keys.
Probe On-Off	Switches the waveform display of the same probes to ON or OFF simultaneously.
All On-Off	Switches the display of all logic waveforms to ON or OFF simultaneously. This can be selected when the cursor is on the waveform display position item.

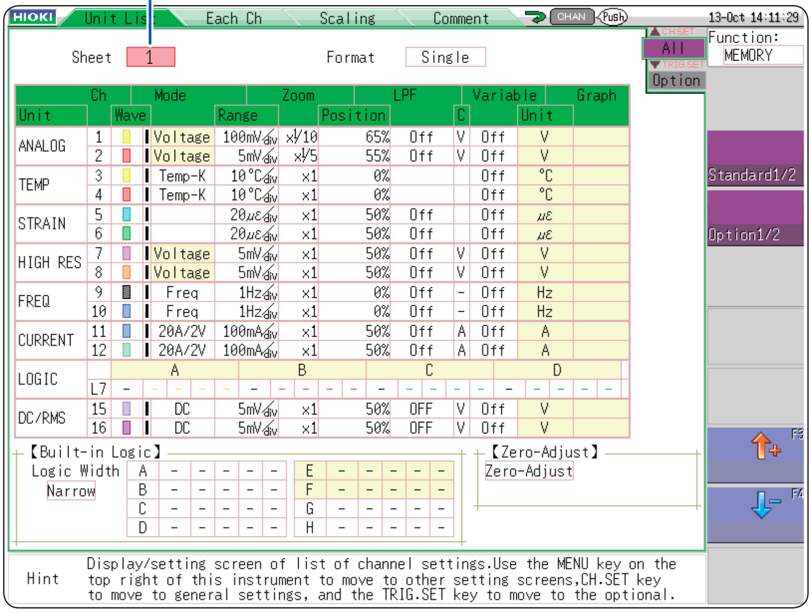
- When the standard logic display (LA, LB, LC, LD, LE, LF, LG, and LH) is **[On]**, 8970 Freq Units installed as unit 1, 2, 9, or 10 cannot be used. Furthermore, the 16-bit resolution 8967 Temp Unit, 8968 High Resolution Unit, 8969 Strain Unit, U8969 Strain Unit, U8974 High Voltage Unit, and U8979 Charge Unit have their resolutions reduced to 12 bits. When Model MR8990 Digital Voltmeter Unit is installed as unit 1, 2, 9, or 10, the standard logic display cannot be used.
- Install logic units as units 1 to 8. Logic units installed as units 9 and above cannot be used.

3.4.4 Displayed Sheet

MEM **REC**

The input channel settings can be set differently for each displayed sheet. Up to four sheets can be set. You can set desired waveforms for displaying to different sheets and switch them.

Sheet switching (1 to 4)



Sheet: 1
Format: Single
Function: MEMORY

Unit	Ch	Wave	Mode	Range	Zoom	Position	LPF	C	Variable	Unit	Graph
ANALOG	1	🟨	Voltage	100mV/div	x1/10	65%	Off	V	Off	V	
	2	🟥	Voltage	5mV/div	x1/5	55%	Off	V	Off	V	
TEMP	3	🟨	Temp-K	10°C/div	x1	0%			Off	°C	
	4	🟥	Temp-K	10°C/div	x1	0%			Off	°C	
STRAIN	5	🟦		20με/div	x1	50%	Off		Off	με	
	6	🟩		20με/div	x1	50%	Off		Off	με	
HIGH RES	7	🟪	Voltage	5mV/div	x1	50%	Off	V	Off	V	
	8	🟧	Voltage	5mV/div	x1	50%	Off	V	Off	V	
FREQ	9	⬛	Freq	1Hz/div	x1	0%	Off	-	Off	Hz	
	10	🟦	Freq	1Hz/div	x1	0%	Off	-	Off	Hz	
CURRENT	11	🟦	20A/2V	100mA/div	x1	50%	Off	A	Off	A	
	12	🟩	20A/2V	100mA/div	x1	50%	Off	A	Off	A	
LOGIC		A		B		C		D			
	L7	- - - - -		- - - - -		- - - - -		- - - - -			
DC/RMS	15	🟪	DC	5mV/div	x1	50%	OFF	V	Off	V	
	16	🟪	DC	5mV/div	x1	50%	OFF	V	Off	V	

【Built-in Logic】

Logic Width: Narrow

A	-	-	-	-	-	E	-	-	-	-	-
B	-	-	-	-	-	F	-	-	-	-	-
C	-	-	-	-	-	G	-	-	-	-	-
D	-	-	-	-	-	H	-	-	-	-	-

【Zero-Adjust】

Zero-Adjust

Hint: Display/setting screen of list of channel settings.Use the MENU key on the top right of this instrument to move to other setting screens,CH.SET key to move to general settings, and the TRIG.SET key to move to the optional.

- Only the following display-related settings can be set to each displayed sheet.

Analog waveform:	Display ON/OFF, waveform color, magnification, zero position, graph variable (ON/OFF, upper/lower limits)
Logic waveform:	Display ON/OFF, waveform color, display position, logic width
X-Y waveform:	Display ON/OFF, display color, X ch, Y ch, waveform calculation (X ch, Y ch)
Common setting:	Display format

- The measurement-related settings other than above will be common to all displayed sheets. When the range is changed, the change is applied to all displayed sheets.
- When a settings file is saved, the settings of all displayed sheets are saved.
- A waveform file is saved based on the setting of the sheet displayed at the time of saving. When a waveform file is loaded, only the sheet displayed at the time of saving can be loaded because other sheets were not saved.

You can configure the waveform calculation settings using the channel setting window. Refer to “3.4 Select Input Channels” (p. 66).

3.5 Start and Stop Measurement

Procedure

Press the **DISP** key to open the Waveform screen.

To Start Measurement

Press the **START** key to start measurement.

- When a measurement is started, waveform data displayed on the screen is cleared.
- Measurement can also be started by applying a signal to the external control terminal.
  Refer to “17 External Control” (p. 343).

To prevent inadvertently starting measurement

To prevent operation mistakes from unintentionally starting measurement, the **START** key operation method can be changed.

Refer to “Start Action” (p. 315).

To automatically save data during measurement

Refer to “5.2.2 Automatically Save Waveforms” (p. 88).

To print the waveform

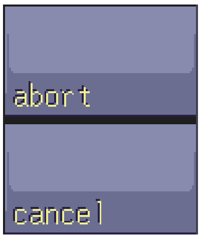
Refer to “6 Printing (When Model U8350 Printer Unit is installed)” (p. 113).

To Stop Measurement

Press the **STOP** key once to stop recording at the end of the specified recording length.
Press the **STOP** key again to stop recording immediately.

The operation conditions for the **START** and **STOP** keys can be changed.
Refer to “15 System Environment Settings” (p. 313).

When **STOP** is pressed, the following indication may appear on the screen.



F 1	Measurement will stop at the point where the key is pressed. (Pressing the **STOP** key twice has the same effect.)
F 2	The stopping procedure will be canceled and measurement will continue.

When no key operation is made in this status, the measurement will stop at the end of the specified recording length and the display returns to the previous screen.

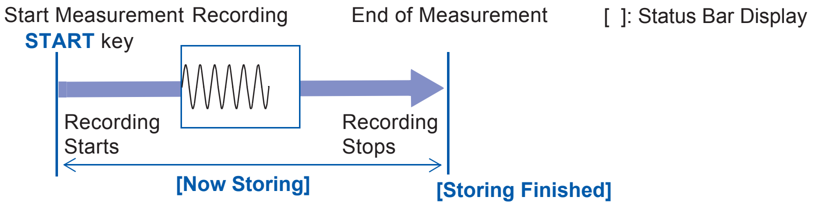
Measurement and Internal Operations

Measurement methods are normal measurement (start recording when measurement starts) and trigger measurement (start recording when trigger criteria are satisfied). In this manual, "**Measurement start**" means when you press the **START** key and "**Recording start**" means when recording begins on the waveform screen.

- **To record on either single or repeating trigger events**
  Select the Trigger mode. (p. 197)
- **To capture data measured prior to trigger events**
  Enable pre-triggering. (p. 209)

Normal Measurement

Without triggering

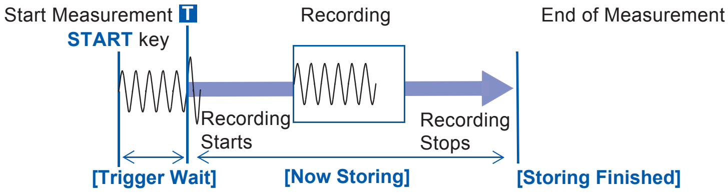


Terminates when measurement up to the recording length has made.

Trigger Measurement

Trigger modes:
[Single]
Pre-triggering not enabled

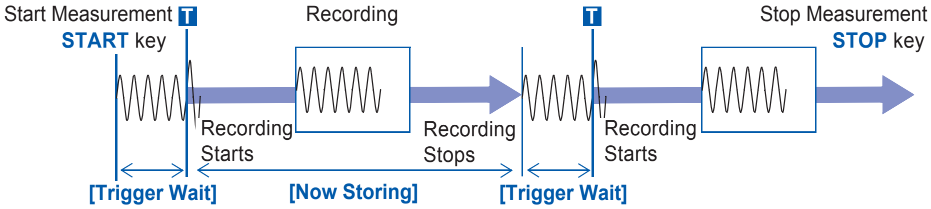
Single triggering



Recording starts when a trigger event occurs and continues for the specified recording length.

Trigger modes:
[Repeat]
Pre-triggering not enabled

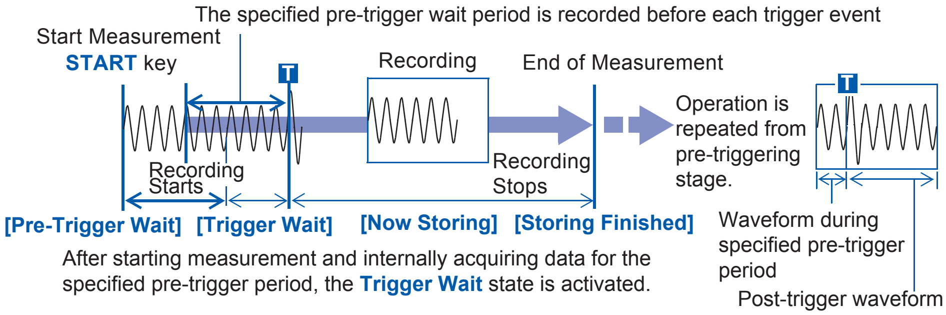
Repeated triggering



Recording starts when a trigger event occurs, continues for the specified recording length, and returns to the Trigger Wait state.

Trigger modes:
[Repeat]
Pre-triggering enabled

Repeated triggering and recording of phenomena before each event



After starting measurement and internally acquiring data for the specified pre-trigger period, the **Trigger Wait** state is activated.

The data before a trigger event (for the pre-trigger period) is recorded.

When the trigger mode is set to **[Repeat]** or **[Auto]** (Memory function only), the number of trigger events is shown in the top part of the screen (Storage Counter). Refer to "Explanation of Screen Contents" (p. 22).

3.6 Measurement With Automatic Range Setting (Auto-ranging Function) MEM

This applies only to the Memory function and analog modules.

When you press the **AUTO** key after inputting a signal to an analog unit, and select **[Auto Range]**, the horizontal axis range (timebase), vertical axis (voltage axis) range, and zero position will be selected and measurement started, all automatically.
The timebase will be set according to the lowest numbered channel among the channels where waveform display is on. It will be set automatically to record 1 to 2.5 cycles in 25 divisions.

When measuring using the auto-ranging function, the following items are adjusted.

Module-Related Conditions (For all channels)	
Vertical axis (Voltage axis) Range	Auto-setup value
Zero Position	
Vertical axis (Voltage axis) magnification	×1
Low-pass filter	Off
Input coupling	DC

Trigger Criteria (For a single channel only)	
Trigger modes	Auto
Trigger source AND/OR	OR
Pre-Trigger	20%
Internal Trigger	Only the lowest numbered channel for which waveform display is On will be On. (If the difference between maximum and minimum value is 8 divisions or less the next lowest numbered channel will be used)
Trigger type	Level trigger: Slope, Rising Trigger level: Auto-setup value Filter: Off

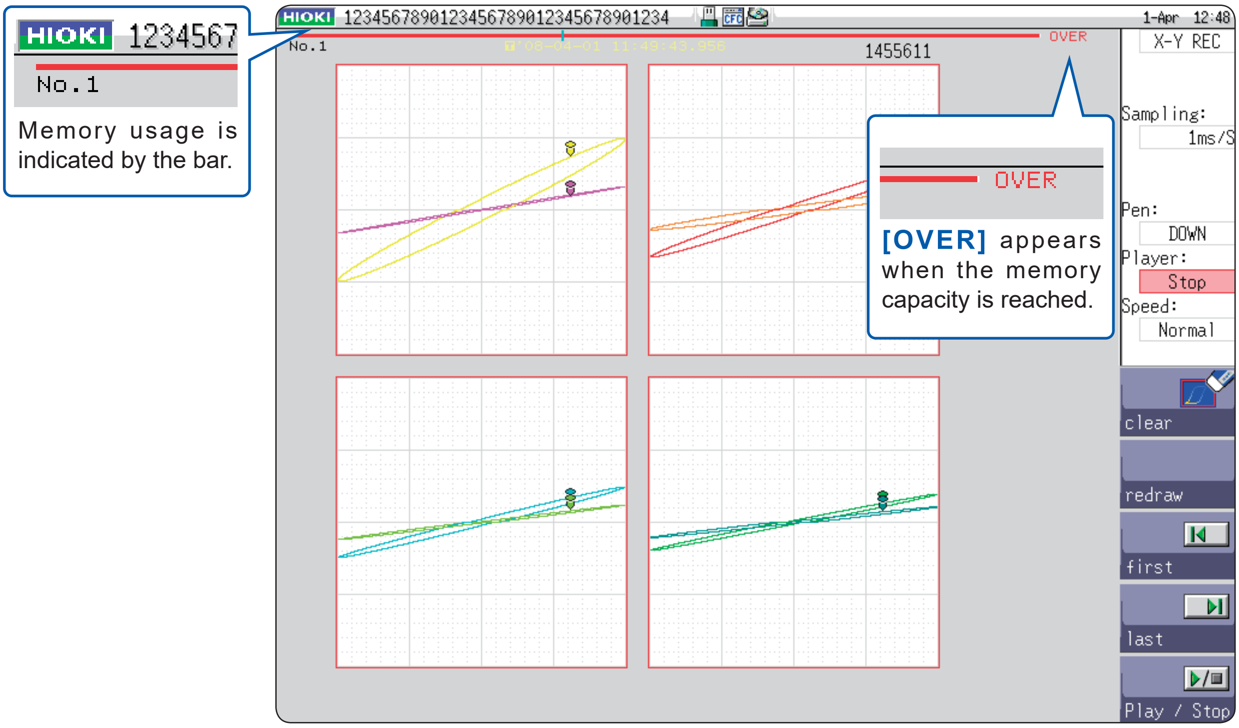
Status Screen - [Status] Sheet Conditions	
Timebase	Auto-setting value (time axis magnification: × 1)

- When measurement is started with the auto-ranging setting, the trigger output signal is output to the external control terminal block's TRIG OUT terminal. Keep this in mind when performing auto-range measurement while using the trigger output terminal.
- The auto-ranging function automatically selects settings for the input signal that is present when the function is enabled. Start auto-ranging measurement after supplying the input signal (waveform).
- If the input signal of the lowest numbered channel selected for waveform display is extremely small, the timebase will be set according to the input signal of the next lowest channel.
- If range could not be set for any channel where waveform display is On, a warning message will appear and measurement will be interrupted.
- The auto-save and auto-print functions cannot be used when measuring with the auto-ranging function.
- For low-frequency signals of less than 10 Hz, the optimal range cannot be selected automatically. Set the range manually.
- Using the following modules disables the auto-range function:
  Models 8967 Temp Unit, 8969 Strain Unit, U8969 Strain Unit, 8970 Freq Unit, MR8990 Digital Voltmeter Unit.

4 X-Y Recorder Function

- The X-Y waveform generated from the input signal is displayed in real time.
- By saving the displayed data in memory, data can be stored as well as printed.
- Similar to an X-Y pen recorder, waveform drawing can be controlled by simulated pen up/down operation.
- Simultaneous observation of up to 8 X-Y phenomena is possible.
- Because waveform information is stored in memory, settings can be changed after measurement for repeated synthesis.

X-Y Recorder Waveform Screen Example (X-Y4 screen)



Memory usage is indicated by the bar.

[OVER] appears when the memory capacity is reached.

Sampling: 1ms/S
Pen: DOWN
Player: Stop
Speed: Normal

4.1 Measurement Workflow

1 Pre-measurement Inspection

Refer to “3.2 Pre-measurement Inspection” (p. 57).

2 Basic Measurement Settings

	Refer to...
Select X-Y recorder as measurement function	“Function” (p. 79)
Set sampling rate	“Sampling” (p. 79)
Determine screen layout format	“Format” (p. 79)
Determine whether to perform waveform interpolation	“Setting Descriptions” (p. 79)
Determine whether to clear previous waveform data	“Disp Clear” (p. 79)

3 Input Channel Settings

Choose analog channel settings

Refer to “3.4.2 Choose Analog Channel Settings” (p. 69).

Logic channels cannot be used.

Application examples

Refer to...
“8.6 Set the Waveform Position (Variable Function)” (p. 164)
“8.7 Fine Adjustment of Input Values (Vernier Function)” (p. 167)
“8.1 Add Comments” (p. 146)
“8.5 Convert Input Values (Scaling Function)” (p. 157)

4 Start Measurement

Refer to...
“4.3 Start and Stop Measurement” (p. 80)
“7.1 Read Measurement Values (Using the AB Cursors)” (p. 128)

With the X-Y recorder function, the following operations are not available:
- Trigger setting
- Auto-saving
- Auto-printing

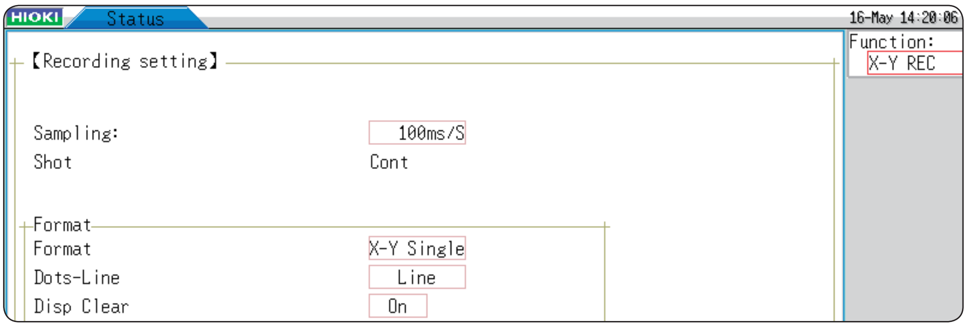
5 Stop Measurement

Refer to...
“4.3 Start and Stop Measurement” (p. 80)
“4 Redraw waveforms” (p. 80)
“5.2.3 Save Data Selectively (SAVE Key)” (p. 94)
“6.3 Manual Printing With the PRINT Key (Selective Printing)” (p. 118)

4.2 Measurement Configuration

To set measurement parameters, press the **STATUS** key to bring up the Status screen and select the **[Status]** sheet. (Settings for measurement function and sampling rate can also be made on the Waveform screen.)

Setting Descriptions



Function:
X-Y REC

【Recording setting】

Sampling: 100ms/S
Shot Cont

Format
Format X-Y Single
Dots-Line Line
Disp Clear On

Function Set the measurement function to X-Y recorder.

Sampling Set the sampling rate.

1 ms / 10 ms / 100 ms *(Default setting)*

[1 ms] can only be selected when **[Dots-Line]** is set to **[Dots]**.

Format Select the graph format for Waveform screen display or printout of the input signal. Up to 8 phenomena can be observed simultaneously.

X-Y Single	The waveforms of graphs 1 - 8 are shown and recorded on a single screen. *(Default setting)*
X-Y Quad	The waveforms of graphs 1 - 8 are shown and recorded on four screens.

Dots-Line (interpolation) Determines whether to display and print the input waveform (sampling data) as dots (sampling points) or perform linear interpolation. Dot display allows faster sampling.

Dots	Display and print sampling data as dots.
Line	Display and print sampling data using linear interpolation. *(Default setting)*

Disp Clear If past waveforms remain at the start of measurement, you can either clear or keep them. If you keep them, the new waveforms will be displayed as an overlay.

Off	Overlay on existing waveforms
On	Clear existing waveforms *(Default setting)*

This completes the measurement configuration settings.
Next, choose analog channel settings.
For details, refer to “3.4.2 Choose Analog Channel Settings” (p. 69).

To set the channels for X-Y synthesis
Refer to “7.4 Perform Waveform X-Y Synthesis” (p. 134).

4.3 Start and Stop Measurement

Press the **DISP** key to go to the Waveform screen.

1 **Start measurement.**

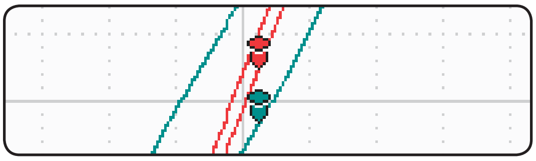
Press the **START** key to start measurement.

2 **Set the pen to Up/Down.**

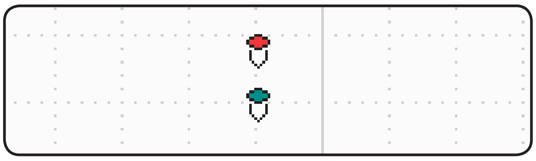
This setting can be chosen before or during measurement. When the pen is set to Down, the waveform is being drawn. When the pen is set to Up, the waveform is not drawn. This setting applies to all channels.
Move the cursor to **[Pen]** to change the setting.

Up	Waveform is not drawn.
Down	Waveform is drawn.

Up/Down operation is also possible using the TRIG.SET key or the Manual Trigger key.



Pen in Down position
Pen is shown in color and waveform is drawn.



Pen in Up position
Pen is shown in white and waveform is not drawn.

3 **Stop measurement**

Press the **STOP** key to stop measurement.

4 **Redraw waveforms**

When measurement is stopped, waveform data for up to 16,000,000 samples before the current point can be played back (redrawn) by the pen, similar to using a video recorder, starting from any specified point. This setting applies to all channels. The playback speed can be specified. (It can also be changed during playback.) Waveform is only played back on the screen and will not affect the printout data. To print the same waveforms as shown on the screen, use the hard copy function (p. 124).

Move the cursor to **[Player]**.

Clear	Clear only waveform display. (Waveform data will not be cleared.)
Redraw	Redraw measurement data. Measurement settings can also be changed for redrawing.
First	Move pen to start of waveform.
Last	Move pen to end of waveform.
Play/Stop	Start/stop waveform playback.

Move the cursor to **[Speed]**.
With the **[Normal]** setting, playback occurs at the same speed as recording.

Very Fast/ Fast /Normal *(Default setting)*/ Slow/Very Slow

Measurement start/stop and pen up/down can be controlled via the external control terminal. (p. 346)

To Redraw With Different Waveform Display Settings

- After clearing the waveform display, waveform data is still retained by the unit. This makes it possible to change the settings for display format, display color, synthesis channels, channel zoom and offset before redrawing the waveform by selecting **[Redraw]**. When **[Redraw]** is executed, the screen and printout data will be renewed.
  (As long as **[Redraw]** is not run, the screen and print data are not refreshed, even if the settings are changed.)
- The jog and shuttle knobs can also be used for redrawing.

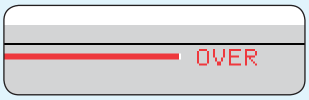
Jog	Move back and forth in the redrawing process in increments of 1 sample.
Shuttle	Move back and forth in the redrawing process at a speed corresponding to the rotation angle.

- When moving backwards, the waveform will be drawn in the direction of earlier data.
  Erasing the waveform is not possible.
- If the measurement exceeds 16,000,000 samples, it is only possible to redraw up to 16,000,000 samples in the past, counting backwards from the point where measurement was stopped. Earlier waveform data is lost.
- Redrawing with the jog-shuttle is only reflected on the screen and will not affect the printout data. To print the same waveforms as shown on the screen, use the hard copy function (p. 124).

4.4 Waveform Observation

Waveform data for up to 16,000,000 samples is stored in memory, and an A/B cursor pair can be used to trace measurement values. (p. 128)
The amount of memory used is indicated by the bar at the top of the screen.

When the number of samples exceeds 16,000,000, the indication **[OVER]** appears at the top of the screen.



4.4.1 To Save and Print Waveforms

Saving The **SAVE** key or the controls on the File screen can be used to save waveform data stored in memory as a file.
Refer to “5.2.3 Save Data Selectively (SAVE Key)” (p. 94).

Data stored as a file this way can be reloaded into the instrument, but cannot be read by a PC.

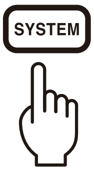
Printing The **PRINT** key can be used to print out waveforms.
Refer to “6.3 Manual Printing With the PRINT Key (Selective Printing)” (p. 118).

5 Save/Load Data and Manage Files

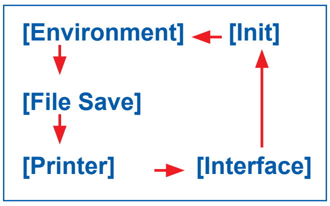
This chapter explains how to save and load data and manage files on your Hioki Memory HiCorder.

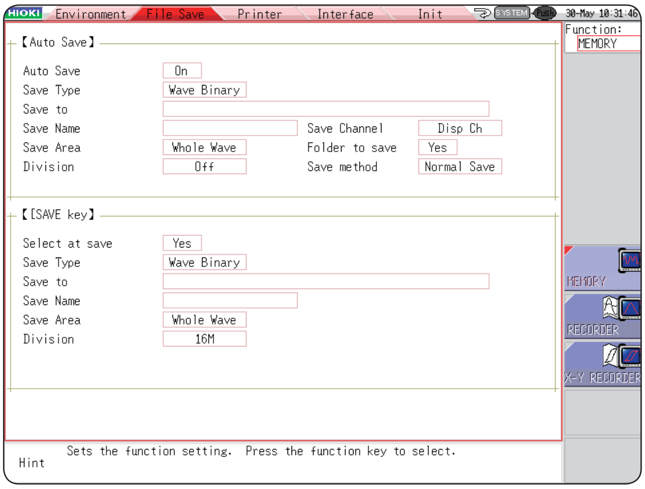
Before saving data, configure the save settings on the **[File Save]** sheet.
You can load data and manage files from the **File screen**.

To Open the [File Save] Sheet



Press this key repeatedly to display the various sheets.





Function: MEMORY

【Auto Save】
Auto Save: On
Save Type: Wave Binary
Save to:
Save Name:
Save Area: Whole Wave
Division: Off
Save Channel: Disp Ch
Folder to save: Yes
Save method: Normal Save

【[SAVE key]】
Select at save: Yes
Save Type: Wave Binary
Save to:
Save Name:
Save Area: Whole Wave
Division: 16M

Hint: Sets the function setting. Press the function key to select.

Operations available from the [File Save] sheet

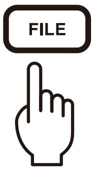
The following settings are available on the **[File Save]** sheet. (p. 87)

Auto-save settings
  Set the method of automatic saving of waveform data.

SAVE key settings
  Set the method of saving when the **SAVE** key is pressed.

To Open the File Screen

Indicated the order in which the files are displayed.
△: Ascending order
▽: Descending order

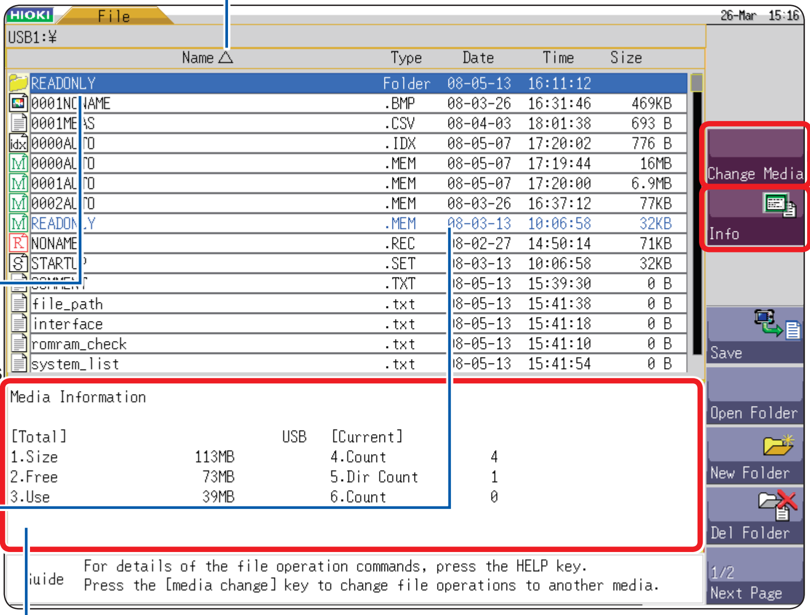


Press this key.

The selected file is indicated by a flashing cursor.

Use the **Right/left CURSOR** keys to move between folder levels.
Use the **Up/down CURSOR** keys to select files.

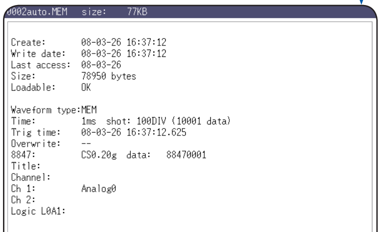
Read-only files and folders are shown in blue.
These files and folders cannot be renamed or deleted.



```
26-Mar  15:16
USB1:¥
Name △                         Type    Date      Time      Size
READONLY                       Folder  08-05-13  16:11:12
0001NONAME                     .BMP    08-03-26  16:31:46   469KB
0001MEAS                       .CSV    08-04-03  18:01:38   693 B
0000AUTO                       .IDX    08-05-07  17:20:02   776 B
0000AUTO                       .MEM    08-05-07  17:19:44    16MB
0001AUTO                       .MEM    08-05-07  17:20:00   6.9MB
0002AUTO                       .MEM    08-03-26  16:37:12    77KB
READONLY                       .MEM    08-03-13  10:06:58    32KB
NONAME                         .REC    08-02-27  14:50:14    71KB
STARTUP                        .SET    08-03-13  10:06:58    32KB
COMMENT                        .TXT    08-05-13  15:39:30     0 B
file_path                      .txt    08-05-13  15:41:38     0 B
interface                      .txt    08-05-13  15:41:18     0 B
romram_check                   .txt    08-05-13  15:41:10     0 B
system_list                    .txt    08-05-13  15:41:54     0 B

Media Information

[Total]                      USB   [Current]
1.Size            113MB            4.Count           4
2.Free             73MB            5.Dir Count       1
3.Use              39MB            6.Count           0

Guide   For details of the file operation commands, press the HELP key.
        Press the [media change] key to change file operations to another media.
```

Storage Media information
Shows information about the selected storage media.

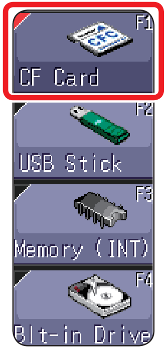
Count:	Displays the number of files in the selected folder.
Dir Count:	Shows the number of folders in the selected folder.
Count:	Shows the number of files and folders that can be created in the selected folder level.



```
0002auto.MEM   size:    77KB

Create:         08-03-26 16:37:12
Write date:     08-03-26 16:37:12
Last access:    08-03-26
Size:           78950 bytes
Loadable:       OK

Waveform type:MEM
Time:           1ms  shot: 100DIV (10001 data)
Trig time:      08-03-26 16:37:12.625
Overwrite:      --
8847:           CS0.20g  data:   88470001
Title:
Channel:
Ch 1:           Analog0
Ch 2:
Logic L0A1:
```

Information is displayed for the selected file.

When Media is not displayed and you cannot perform any operations n the file screen, choose a setting other than **[Mass storage HDD]** or **[Mass storage CF]** for **[USB Set]**.



To Change Media

1 **Verify that storage media is inserted.**
Refer to "2.3 Prepare Storage Media" (p. 46).

2 **Select [Change Media] and select a storage media type.**
The files on the selected storage media will be displayed in the file list.

Operations available from the File screen

Format storage media	**(p. 48)**
Load data	**(p. 99)**
Save/load an auto-settings file	**(p. 102)**

Manage files **(p. 87)**

- Save data (p. 104)
- Create new folders (p. 106)
- Copy files (p. 110)
- Sort files (p. 108)
- Delete files (p. 107)
- Rename files (p. 109)
- Print the File List (p. 111)

5.1 Data That Can Be Saved and Loaded

✓: Possible, —: Not possible

File type	File format	Icon	File extension and description		Save		Load	PC readable
					Auto	Manual		
Settings data[*1]	Binary	S	SET	Settings data (Measurement Configuration)	—	✓	✓	—
Waveform data[*2] Entire waveform acquired by the instrument or a section of the waveform specified with the A and B cursors.	Binary	M	MEM	Memory Function waveform data	✓	✓	✓	—[*4]
		R	REC	Recorder Function waveform data	✓	✓	✓	—[*4]
		XY	XYC	X-Y Recorder Function waveform data	—	✓	✓	—
		F	FFT	FFT Function data	✓	✓	✓	—
	Text	📄	CSV	Text Data	✓	✓	—	✓
Waveform Management Data[*3] (Divided Saving)	(Index file)	idx	IDX	Index data for divided saving	✓	✓	✓	—
		SEQ	SEQ	Index data for memory division (automatically created during batch saving)	✓	✓	✓	—
Captured Screen Image (Display/ Waveform screens)	BMP[*5]	🖼	BMP	Image Data	—	✓	—	✓
Numerical Calculation Results	Text	📄	CSV	Text Data	✓	✓	—	✓
Comments for Printing	Text	📄	TXT	Text Data	—	—	✓[*6]	✓
Waveform evaluation setting data	Binary	A	ARE	Settings data (Measurement conditions + waveform evaluation areas)	—	✓	✓	—
Waveform evaluation area	BMP	🖼	BMP	Waveform evaluation area image data	—	✓	✓	✓
Arbitrary waveform data	Binary	WFG	WFG	Arbitrary waveform data (For U8793)	—	✓	✓	—
Arbitrary waveform data	Text	TFG	TFG	Arbitrary waveform data (For U8793)	—	—	✓	✓
Pulse pattern data	Binary	PLS	PLS	Pulse pattern data (For MR8791)	—	✓	✓	—
Generation program data	Program	FGP	FGP	Generation program data (For U8793)	—	✓	✓	—

*1: Multiple data can be saved in the instrument, and loaded selectively. Automatic loading at power-on is also possible. (p. 102)

*2: When data is to be reloaded on the instrument, save it in binary format. Waveforms and some measurement settings can be saved for reloading.
When the data is to be loaded on a PC, save it in text format. (p. 87)
When saving a section of a waveform, use the A and B cursors to set the section to be saved. (p. 128), (p. 131)

*3: When you want to use memory division and load all blocks at the same time:
Save measurement data using **[All blocks]**. A directory will be created automatically and waveform data for each block and index data (SEQ) will be created. When loading, load this index data.
When loading waveform data from divided saving, import the IDX index data.

*4: Loading is possible with Wave Viewer (Wv).

*5: This is a standard Windows® graphics format. Files in this format can be handled by many graphics programs.

*6: It is possible to print out loaded waveforms with text files created on a PC. Other processing operations are not available.

> Files larger than 2 GB cannot be saved.

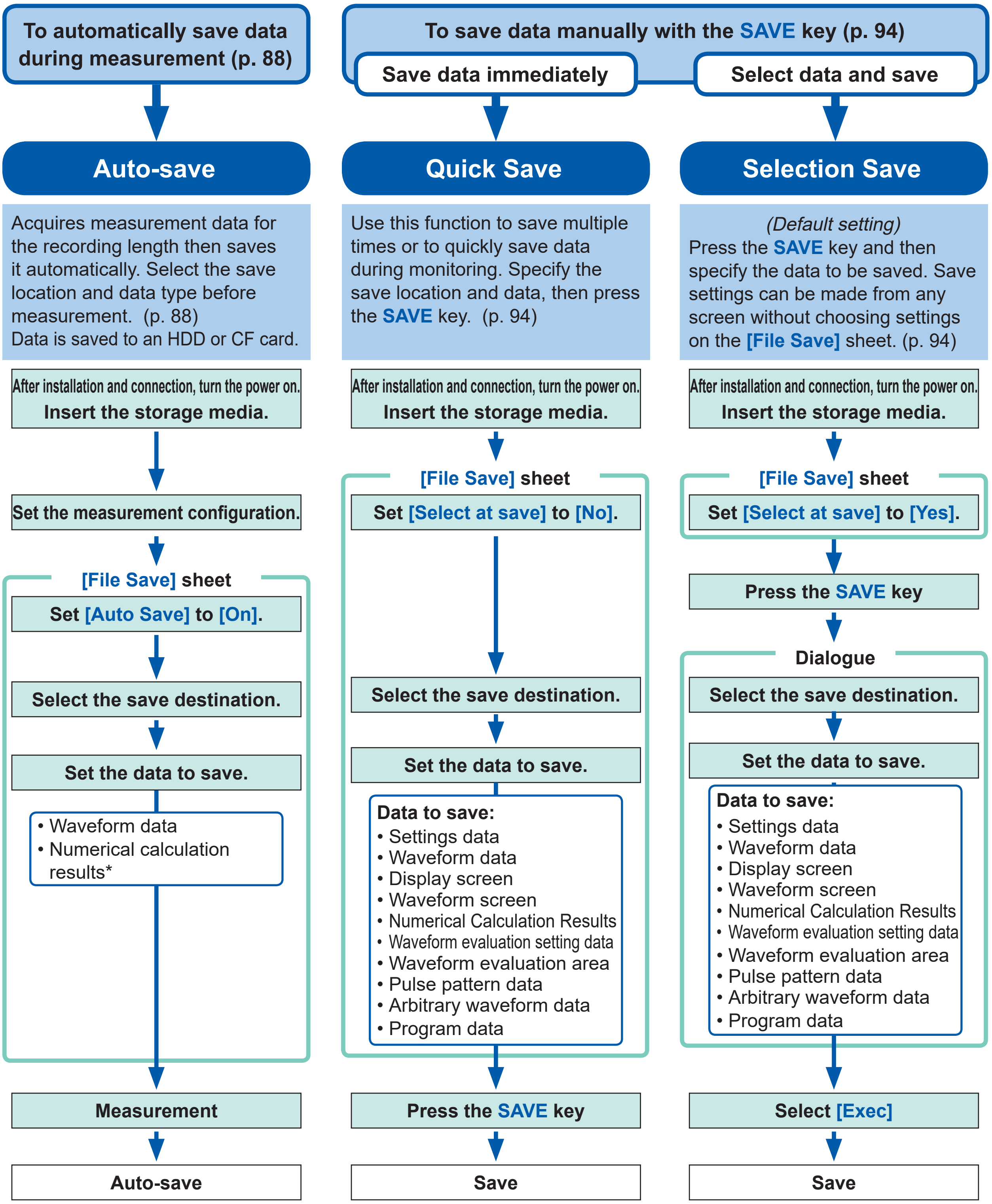
Data That Cannot Be Loaded on the Instrument

- Data saved by other instruments.
- Image files other than waveform evaluation areas (🖼)
- ? Files displayed with this icon.

5.2 Save Data

5.2.1 Save Types and Workflow

There are basically three types of save operations.



To automatically save data during measurement (p. 88)

Auto-save

Acquires measurement data for the recording length then saves it automatically. Select the save location and data type before measurement. (p. 88)
Data is saved to an HDD or CF card.

After installation and connection, turn the power on.
Insert the storage media.
Set the measurement configuration.
[File Save] sheet
Set [Auto Save] to [On].
Select the save destination.
Set the data to save.
- Waveform data
- Numerical calculation results*

Measurement
Auto-save

To save data manually with the SAVE key (p. 94)

Save data immediately

Quick Save

Use this function to save multiple times or to quickly save data during monitoring. Specify the save location and data, then press the **SAVE** key. (p. 94)

After installation and connection, turn the power on.
Insert the storage media.
[File Save] sheet
Set [Select at save] to [No].
Select the save destination.
Set the data to save.

Data to save:
- Settings data
- Waveform data
- Display screen
- Waveform screen
- Numerical Calculation Results
- Waveform evaluation setting data
- Waveform evaluation area
- Pulse pattern data
- Arbitrary waveform data
- Program data

Press the SAVE key
Save

Select data and save

Selection Save

(Default setting)
Press the **SAVE** key and then specify the data to be saved. Save settings can be made from any screen without choosing settings on the **[File Save]** sheet. (p. 94)

After installation and connection, turn the power on.
Insert the storage media.
[File Save] sheet
Set [Select at save] to [Yes].
Press the SAVE key
Dialogue
Select the save destination.
Set the data to save.

Data to save:
- Settings data
- Waveform data
- Display screen
- Waveform screen
- Numerical Calculation Results
- Waveform evaluation setting data
- Waveform evaluation area
- Pulse pattern data
- Arbitrary waveform data
- Program data

Select [Exec]
Save

Check before saving:
- **Is the storage media inserted and initialized? (p. 46), (p. 48)**
- **Is the save location specified correctly?**
- **Is auto-save set to [On]? (For auto-saving)**

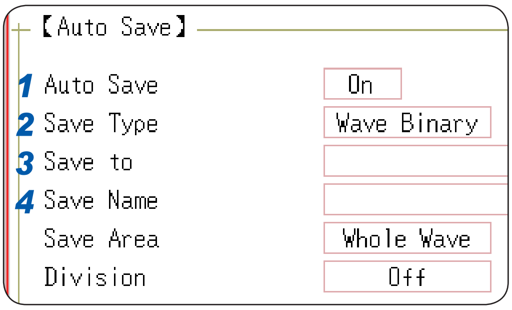
*** To save numerical calculation results**
Refer to “10.4 Save Numerical Calculation Results” (p. 227).

5.2.2 Automatically Save Waveforms

This function acquires measurement data for the recording length then saves the waveform data automatically. The save location and data to be saved must be selected before measurement starts.

Procedure

Press the **SYSTEM** key to open the System screen. → **[File Save]** sheet



【Auto Save】

1 Auto Save: On
2 Save Type: Wave Binary
3 Save to:
4 Save Name:
Save Area: Whole Wave
Division: Off

1 **Enable auto-save.**

Move the cursor to **[Auto Save]**, and select **[On]**.

Default setting: Off (no automatic saving)

2 **Set the data to be saved.**

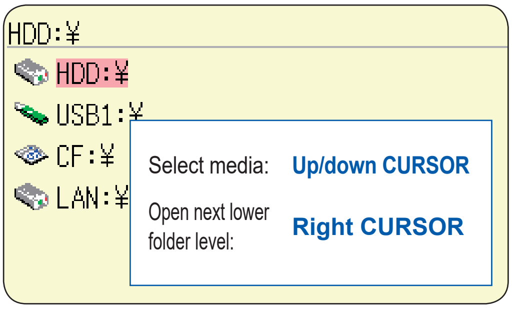
Move the cursor to **[Save Type]**.

Wave Binary	Save waveform data in binary format. (Data saved in binary format can only be loaded on this instrument.)
Wave Text	Save waveform data in text format. The data can be thinned out then saved. (This data can be opened by a PC editor or spreadsheet software, but it cannot be reloaded on this instrument.)

3 **Set the save destination.**

Move the cursor to **[Save To]**, and select **[Edit]**.

The Browse folders dialog box appears (at bottom right).



Select media: Up/down CURSOR
Open next lower folder level: Right CURSOR

Move the cursor to the storage media you want to save the data to and confirm the setting with **[Confirm]**.

HDD	Automatically save the waveform data on the built-in drive. (When Model U8330 SSD Unit is installed)
CF	Automatically save the waveform data on a CF card.
USB	Automatically save the waveform data on a USB memory stick.
LAN	Automatically save the waveform data on a PC connected via LAN. Model 9333 LAN Communicator required.

When the root directory (topmost folder on the storage media) is selected, a folder named “HIOKI_MR8827” will be created automatically. (If the media was formatted by the instrument, the folder will already have been created.) This folder is then used as the save location.

To create a new folder to use as the save target, select **[New Folder]**. When **[LAN]** is set as the save destination, **[New Folder]** is ignored and a folder named with the current date will be created.

*

- **To save the waveform data on a PC connected via LAN**
  The 9333 LAN Communicator must be installed on the PC on which the data is to be saved. For more information about how to operate and configure the Model 9333 LAN Communicator, as well as install it on a PC, refer to the instruction manual of Model 9333 LAN Communicator.
- **When setting the save destination to [LAN]**
  You must first set the IP addresses of the unit and the PC connected via LAN. For more information about how to set the IP addresses, refer to (p. 318).

4 **Set the file name.**

Move the cursor to **[Save Name]**, and enter a file name.
Refer to "8.1.3 Alphanumeric Input" (p. 149).

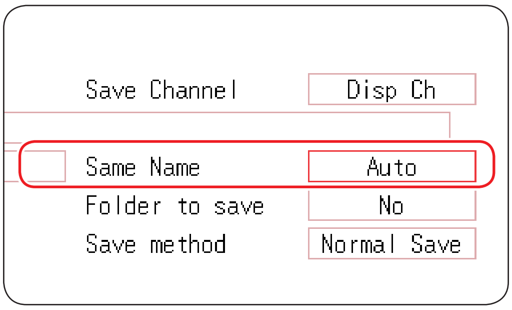
When **[LAN]** is set as the save destination, **[Save Name]** is ignored and the files will be named in the previously-determined format.
Refer to "Save Operations (When Setting the Save Destination to [LAN])" (p. 93).

File name
The maximum number of characters for **[Save Name]** is 123. The maximum path length including file name is 255 characters.

5 **Specify the action if a file with the same name exists in the target folder.**

Move the cursor to **[Same Name]**.

Auto	If no files with the same name exist, saves the file with the designated name. Otherwise, a 4-digit number is automatically added to the eginning of the file name (default setting). If the first character of the file name is a numeral, the added number will continue sequentially from that number.
Serial	Unconditionally, a 4-digit number is automatically added to the beginning of the file name. If a file with the same name exists, saves the file, adding the 4-digit number that is increased by 1.

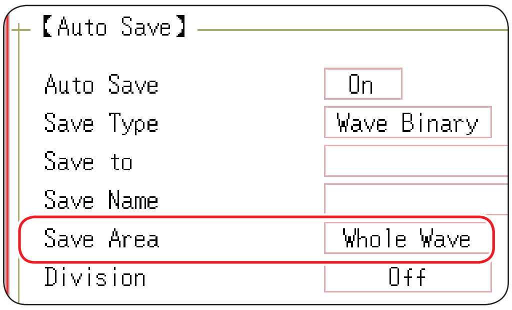


Save Channel Disp Ch
Same Name Auto
Folder to save No
Save method Normal Save

6 **Set the save area.**

Move the cursor to **[Save Area]**.

Whole Wave	Save all recorded data. (*Default setting*)
A-B Wave	Save the data between the A and B cursors. If only cursor A is set, all data after the cursor will be saved. To specify the AB cursors (p. 128)

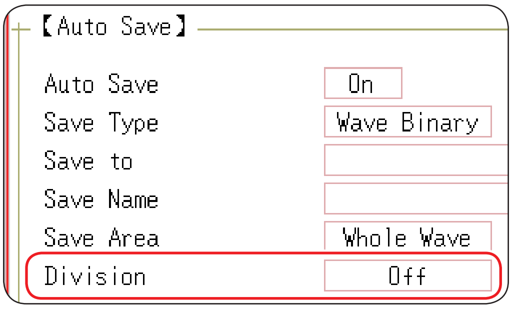


【Auto Save】
Auto Save On
Save Type Wave Binary
Save to
Save Name
Save Area Whole Wave
Division Off

7 **(When the selected save type is [Wave Binary])**
Select whether to save divided files.

Move the cursor to **[Division]**.

Off	Files are not divided when saved.
16M, 32M, 64M	Select the size for Divided Save.



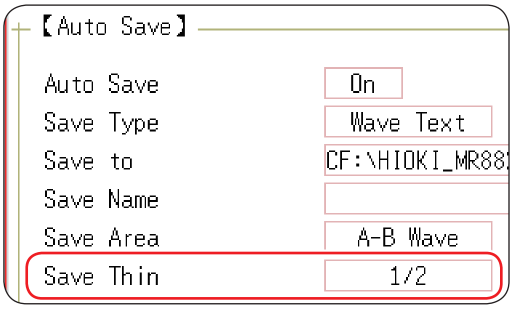
【Auto Save】
Auto Save On
Save Type Wave Binary
Save to
Save Name
Save Area Whole Wave
Division Off

(When [Wave Text] is selected as the save type)

Set the data thinning amount.

Move the cursor to **[Save Thin]**.

Off	No data thinning (sub-sampling).
1/2 to 1/1000	Set the thinning amount (the fraction of the total data to retain).



【Auto Save】

Auto Save: On

Save Type: Wave Text

Save to: CF:\HIOKI_MR88

Save Name:

Save Area: A-B Wave

Save Thin: 1/2

About divided saving

- Large quantities of waveform data can be divided and saved as multiple files.
- Saving divided data automatically makes a folder then creates one or more waveform files and an index (IDX) file in that folder. The IDX file can be used to load the data in the waveform file(s) as a batch.
- When divided saving is selected, delete save (p. 76) is not available.
- Automatic divided saving is not possible when using the memory division function.

Refer to "Divided files are loaded together." (p. 101) or "12 Memory Division Function" (p. 245).

Thinning

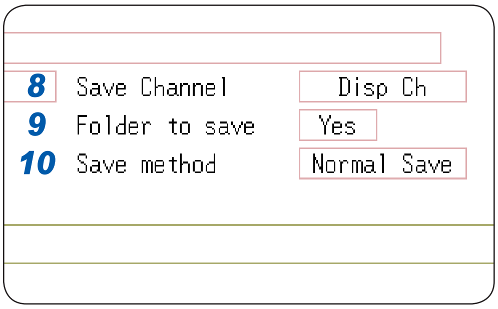
A large amount of space is required to save files in the text format. Data thinning reduced the file size.

Example: When **[1/2]** is set, every second data item is saved.
The number of data items is reduced to 1/2 the original amount.

8 **Select the channels to save.**

Move the cursor to **[Save Ch].**

Disp Ch	Saves the channels of all sheets for which waveform display is set to **[On]**. (*Default setting*)
All Ch	Saves all measured channels (When using the memory function, saves channels which have been set as **[Used Ch]** on the Status settings screen). Saves the channels for which waveform display is set to **[Off]**.



8 Save Channel: Disp Ch

9 Folder to save: Yes

10 Save method: Normal Save

9 **Set whether to create folders.**

Move the cursor to **[Folder to save].**

No	A folder is not created when measurement starts.
Yes	A folder is created automatically when measurement starts and files are saved in this folder.

When **[LAN]** is set as the save destination, **[New Folder]** is ignored and a folder named with the current date will be created.

10 Set the save method for when the storage media runs out of space.

Move the cursor to **[Save method]**.

Normal Save	Automatic saving stops when the storage media is full.
Delete Save	Old files are deleted and automatic saving is continues when the storage media is full. (Waveform files only.) Waveform files saved after measurement started are deleted in the order in which they were saved (oldest first). No waveform files already saved on the media when measurement started will be deleted.

When [LAN] is set as the save destination, this setting is ignored and the save method becomes [Normal Save].

11 Confirm the measurement configuration then start measurement.

Press the **START** key.

After the data is acquired, the screen image is saved automatically to the specified storage media.

- **Maximum number of files per folder**
  The combined maximum for files and folders created in one folder is 5,000.
  Refer to “Auto-save Operations (When Setting the Save Destination to Storage Media)” (p. 92).
- **[Preparing files] display**
  Sometimes **[Preparing files]** is displayed after measurement starts. This indicates that the instrument is checking the status of the destination where the file will be saved. The more the files exist in the destination folder, the longer the preparation takes.
  When printing is attempted simultaneously with saving, the printing may override the saving and **[Preparing files]** may be displayed longer.

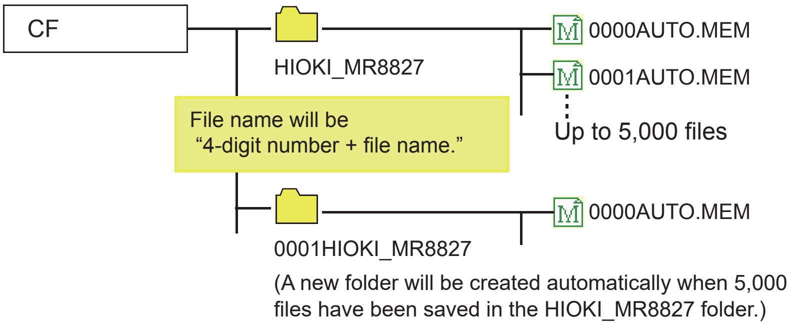
To clear the Auto Save dialog box

Press the **SAVE** key to toggle dialog box display.

Auto-save Operations (When Setting the Save Destination to Storage Media)

Example 1 Saving Files to the Topmost Directory of the Storage Media (A folder named “HIOKI_MR8827” will be created and files saved there)

Save to	CF:¥HIOKI_ MR8827
Save method	Normal Save
Folder to save	Off



File name will be “4-digit number + file name.”

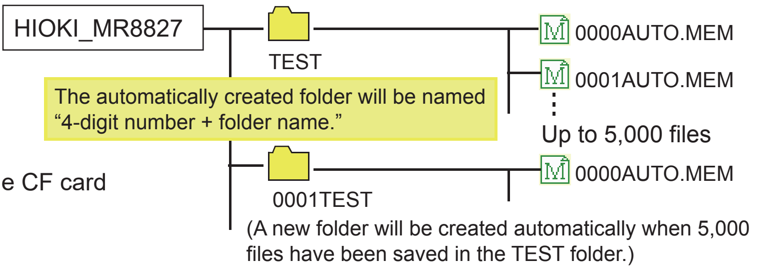
(A new folder will be created automatically when 5,000 files have been saved in the HIOKI_MR8827 folder.)

When the storage media is full:
Automatic saving stop.

Example 2 Saving Files to a Folder on Storage Media

Save to	CF:¥HIOKI_ MR8827¥TEST
Save method	Normal Save
Folder to save	Off

(Create a folder named “TEST” on the CF card beforehand.)



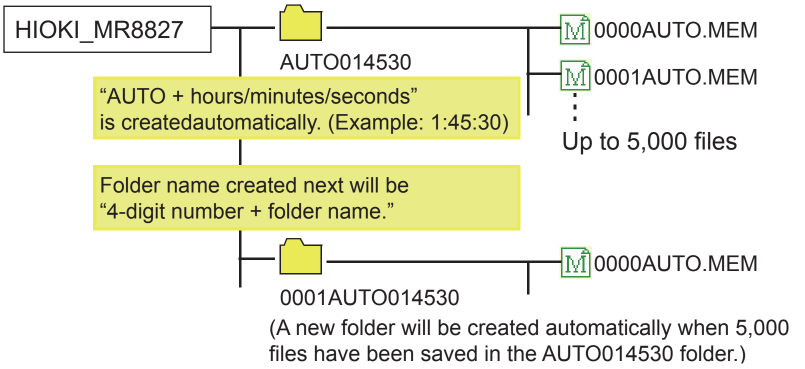
The automatically created folder will be named “4-digit number + folder name.”

(A new folder will be created automatically when 5,000 files have been saved in the TEST folder.)

When the storage media is full:
Automatic saving stop.

Example 3 Create a folder on storage media automatically and save data there

Save to	CF:¥HIOKI_ MR8827
Save method	Normal Save
Folder to save	On



“AUTO + hours/minutes/seconds” is createdautomatically. (Example: 1:45:30)

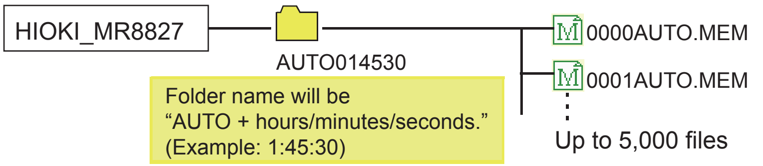
Folder name created next will be “4-digit number + folder name.”

(A new folder will be created automatically when 5,000 files have been saved in the AUTO014530 folder.)

When the storage media is full:
Automatic saving stop.

Example 4 Using Delete/Save to Automatically Save Data

Save to	CF:¥HIOKI_ MR88 27 or a specified folder in the HIOKI_ MR8827 folder
Save method	Delete Save
Folder to save	Off



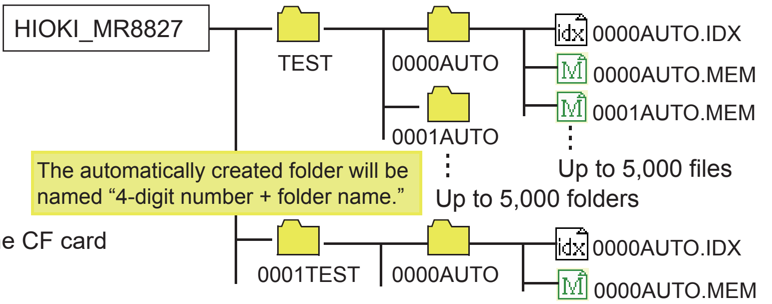
Folder name will be “AUTO + hours/minutes/seconds.” (Example: 1:45:30)

When the number of files in the folder has reached 5,000, or when the storage media is full, files in the AUTO014530 folder (or specified folder) will automatically be deleted in sequence, starting from the oldest file, and replaced by new files.
Only waveform files will be deleted.

Example 5 **Saving data in an existing folder on the media using divided saving**

Save to	CF:¥HIOKI_MR8827¥TEST
Save method	Normal Save
Folder to save	Off

(Create a folder named "TEST" on the CF card beforehand.)



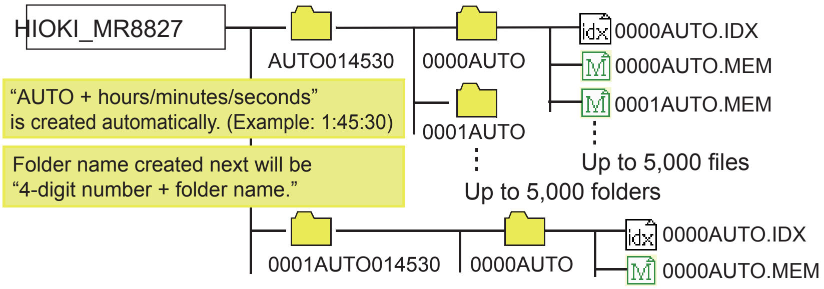
The automatically created folder will be named "4-digit number + folder name."

(A new folder will be created automatically when 5,000 folders have been saved in the TEST folder.)

When the storage media is full:
Automatic saving stop.

Example 6 **Saving data in an automatically created folder on storage media using divided saving**

Save to	CF:¥HIOKI_MR8827
Save method	Normal Save
Folder to save	On



"AUTO + hours/minutes/seconds" is created automatically. (Example: 1:45:30)

Folder name created next will be "4-digit number + folder name."

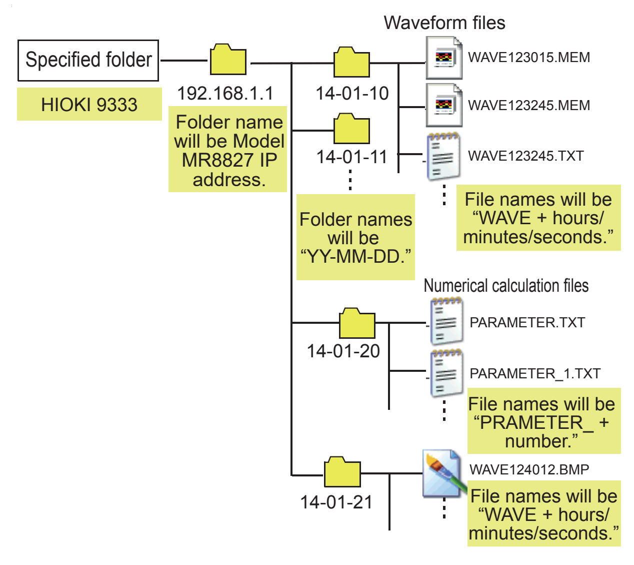
(A new folder will be created automatically when 5,000 folders have been saved in the AUTO014530 folder.)

When the storage media is full:
Automatic saving stop.

Save Operations (When Setting the Save Destination to [LAN])

The file is saved according to the method (on the right figure) specified under **[Save Settings]** using the 9333 LAN Communicator.
For more information about how to configure save settings, refer to the instruction manual for the 9333 LAN Communicator.

The destination folders and files are named in the previously-determined formats and saved as follows:



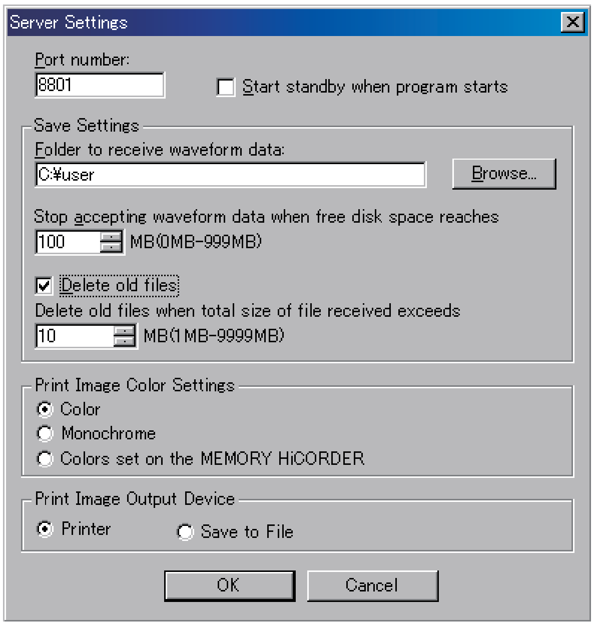
Folder name will be Model MR8827 IP address.

Folder names will be "YY-MM-DD."

File names will be "WAVE + hours/minutes/seconds."

File names will be "PRAMETER_ + number."

File names will be "WAVE + hours/minutes/seconds."


Server Settings

Port number: 8801

☐ Start standby when program starts

Save Settings

Folder to receive waveform data: C:¥user

Stop accepting waveform data when free disk space reaches 100 MB(0MB-999MB)

☑ Delete old files

Delete old files when total size of file received exceeds 10 MB(1MB-9999MB)

Print Image Color Settings

● Color
○ Monochrome
○ Colors set on the MEMORY HiCORDER

Print Image Output Device

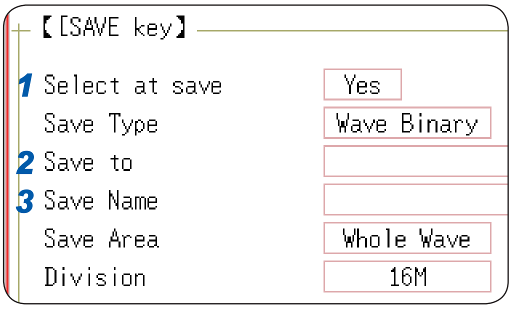
● Printer ○ Save to File

5.2.3 Save Data Selectively (SAVE Key)

To use the **SAVE** key for quick saving, you first need to set the saving conditions.
The following types of data can be saved: setting data, waveform data, display screens, waveform screen, and numerical calculation results.

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[File Save]** sheet.



【[SAVE key】

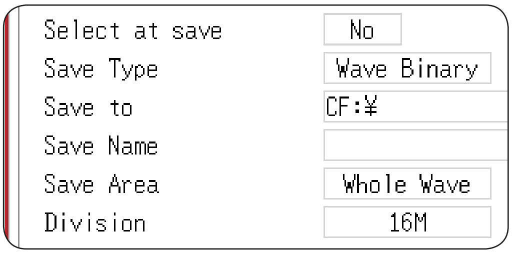
1 Select at save: Yes
Save Type: Wave Binary
2 Save to:
3 Save Name:
Save Area: Whole Wave
Division: 16M

1 **Set the save method for when the SAVE key is pressed.**

Move the cursor to the **[Select at save]** item, and select **[No]**.

Yes	After pressing the **SAVE** key, a dialog box will appear to select data before saving. *(Default setting)* Refer to “Selection Save” (p. 87).
No	The preset data is saved when you press the **SAVE** key. Refer to “Quick Save” (p. 87).

When **[Yes]** is selected, the following setting determines which dialog box appears when you press the **SAVE** key. (Middle screen at right)
This does not apply when other dialogs such as the “Folder Reference Dialog” are being displayed.

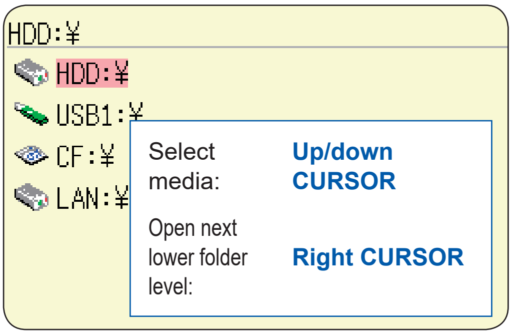


Select at save: No
Save Type: Wave Binary
Save to: CF:¥
Save Name:
Save Area: Whole Wave
Division: 16M

2 **Set the save destination.**

Move the cursor to **[Save To]**, and select **[Edit]**.

The Browse folders dialog box appears (at bottom right).



HDD:¥
HDD:¥
USB1:¥
CF:¥
LAN:¥

Select media:	**Up/down CURSOR**
Open next lower folder level:	**Right CURSOR**

Move the cursor to the storage media you want to save the data to and confirm the setting with **[Confirm]**.

HDD	Automatically save the waveform data on the built-in drive. (When Model U8330 SSD Unit is installed)
CF	Automatically save the waveform data on a CF card.
USB	Automatically save the waveform data on a USB memory stick.
LAN	Automatically save the waveform data on a PC connected via LAN. Model 9333 LAN Communicator required.

When the root directory (topmost folder on the storage media) is selected, a folder named “HIOKI_MR8827” will be created automatically. (If the media was formatted by the instrument, the folder will already have been created.) This folder is then used as the save location.

To create a new folder to use as the save target, select **[New Folder]**. When **[LAN]** is set as the save destination, **[New Folder]** is ignored and a folder named with the current date will be created.

3 Set the file name.

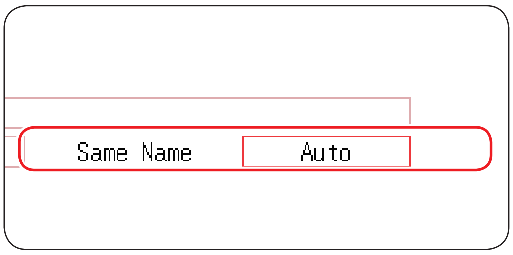
Move the cursor to **[Save Name]**, and enter a file name.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

When **[LAN]** is set as the save destination, **[Save Name]** is ignored and the files will be named in the previously-determined format.
Refer to “Save Operations (When Setting the Save Destination to [LAN])” (p. 93).

File Name
The maximum number of characters for **[Save Name]** is 123. The maximum path length including file name is 255 characters.

4 Specify the action if a file with the same name exists in the target folder.

Move the cursor to **[Same Name]**.

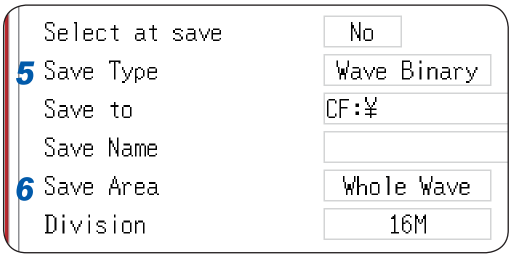


Same Name Auto

Auto	If no files with the same name exist, saves the file with the designated name. Otherwise, a 4-digit number is automatically added to the beginning of the file name (default setting). If the first character of the file name is a numeral, the added number will continue sequentially from that number.
Serial	Unconditionally, a 4-digit number is utomatically added to the beginning of the file name. If a file with the same name exists, saves the file, adding the 4-digit number that is increased by 1.

5 **Set to save.**

Move the cursor to **[Save Type]**.



Select at save	No
Save Type	Wave Binary
Save to	CF:¥
Save Name	
Save Area	Whole Wave
Division	16M

Set	Save the settings data.
Wave Binary	Save waveform data in binary format. Select this to be able to reload the waveform on the instrument.
Wave Text	Save waveform data in text format. Select this to use the waveform data on a PC. (Memory/Recorder/FFT Function only)
Wave ALLWave Bin	Save data for all blocks in binary format. (Only when the memory division setting is **[On]**.)
Wave ALLWave Txt	Save waveform data in text format. (When the memory division setting is **[On]**)
Screen Copy	Save screen display data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
Wave Image	Save printer output data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
Numerical Calculation Results	Save numerical calculation results. (Memory Function only)
Waveform evaluation settings	Save settings data and waveform evaluation areas.
Waveform evaluation area	Save evaluation areas created with the waveform evaluation function as black-and-white BMP files. Saved data can be edited on a PC and loaded back into the instrument. Edit images in black and white only.
Pulse pattern	Saves pulse patterns registerd in the MR8791.
Arbitrary waveform	Saves arbitrary waveforms registered in the U8793.
Program	Saves program data registered in the U8793.

6 **(When Wave Binary or Wave Text has been selected)**

Move the cursor to [Save Area].

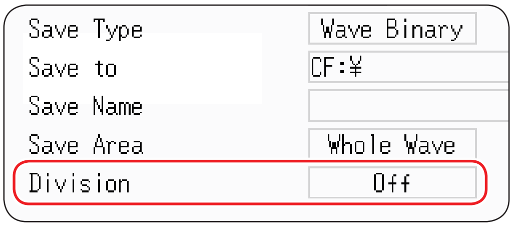
Whole Wave	Save all recorded data. (*Default setting*)
A-B Wave	Save the data between the A and B cursors. If only cursor A is set, all data after the cursor will be saved. Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131).

The channel displayed on the screen will be saved.

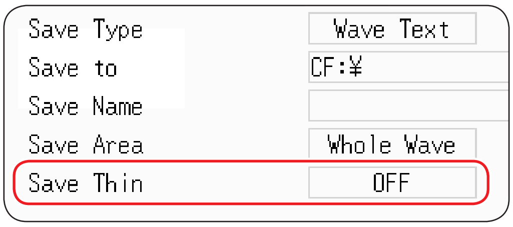
7 Advanced settings

Available settings will differ depending on the save type.

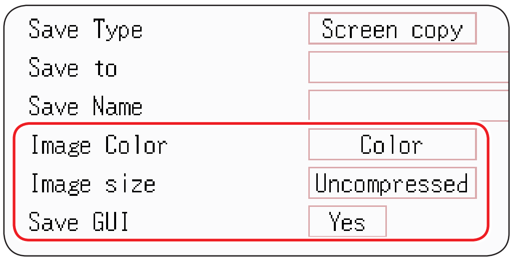
Save types	Settings	Description
Setting	-	-
Wave Binary	**Division**	**(Off, 16 M, 32 M, 64 M)** Select this to divide large files into several files when saving. A folder with the specified name will be created and data saved as multiple files in that folder.
Wave Text	**Save Thin**	**(Off, 1/2 to 1/1000)** Select this to use thinning (sub-sampling) when saving text data. Set the thinning amount (the fraction of the total data to retain).
Screen Copy (Hard copy of the display)	**Image Color**	**(Color, Gray, Mono, Mono [Rev])** Specifies the color palette of the created image file.
	Image size	**(UnCompressed, Compressed)** Determines whether the image file is compressed.
	Save GUI	**(Yes, No)** Determines whether the GUI will be saved in the image.
Wave Image (Print image)	**Output File**	**(All, 1 to 250)** Specifies the number of files to save. To specify a range, open the **[Printer]** sheet from the System screen and set the printing area to **[A-B Wave]**. (Memory/Recorder Function only)
	Wave Image Shot	**(1 to 60 div)** Specifies the amount of data per file. If the amount of measurement data is lower than the entered number of divisions, only the actual measurement data amount will be saved. (Memory/Recorder Function only)
Calc Result	**Folder to save**	**(New File, Existing File)** Determines whether data is saved under a new file name every time (with automatically incremented number if the same file name exists), or appended to the same file.



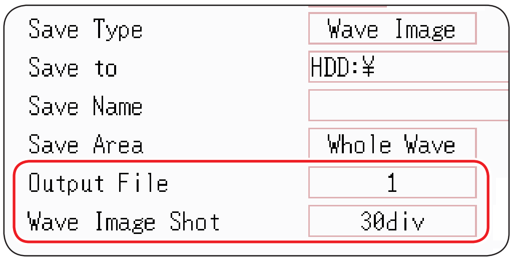
Save Type Wave Binary
Save to CF:¥
Save Name
Save Area Whole Wave
Division Off



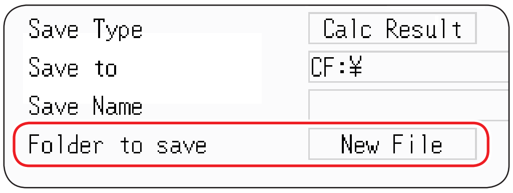
Save Type Wave Text
Save to CF:¥
Save Name
Save Area Whole Wave
Save Thin OFF



Save Type Screen copy
Save to
Save Name
Image Color Color
Image size Uncompressed
Save GUI Yes



Save Type Wave Image
Save to HDD:¥
Save Name
Save Area Whole Wave
Output File 1
Wave Image Shot 30div



Save Type Calc Result
Save to CF:¥
Save Name
Folder to save New File

8 (For memory function)
When using the memory division function

Select the blocks to be saved
Move the cursor to **[Save Block]**.

All Blks	Saves all blocks with waveforms.
Start-End	Saves all used blocks beginning from the start block.

This completes the data save settings.
These settings will be used whenever the **SAVE** key is pressed.

If “Image size” is used when saving a display image file, the image may not be viewable with some image viewer applications.

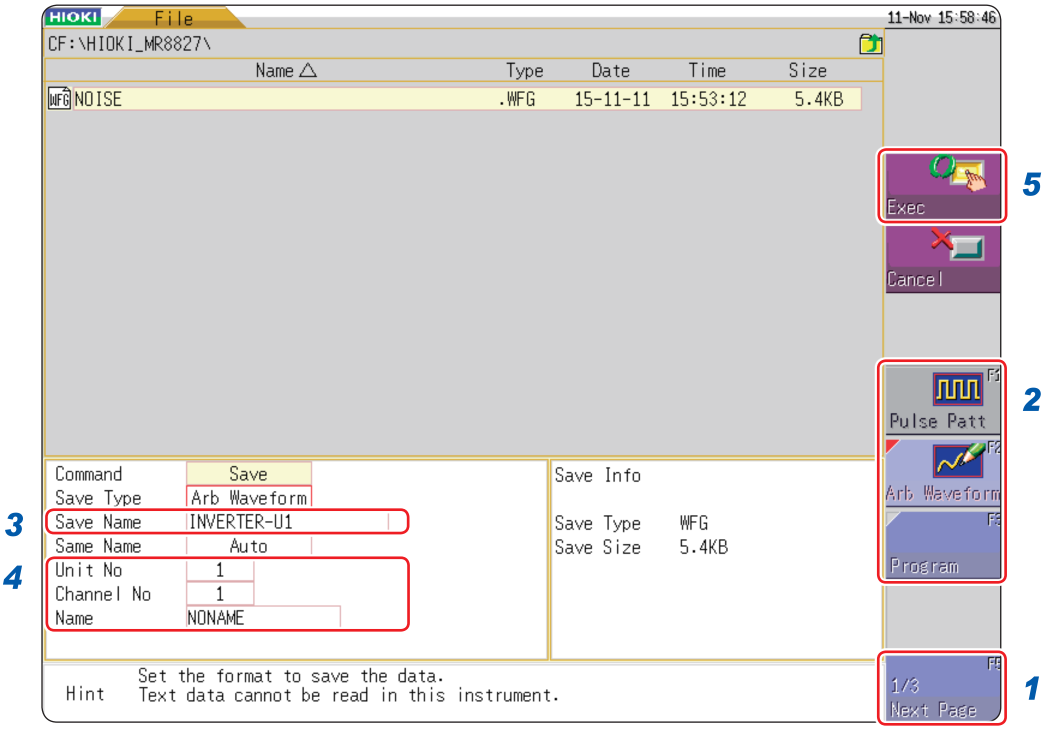
5.2.4 Save Waveform Output Data to the Media

The pulse pattern data registered in Model MR8791, arbitrary waveform data registered in Model U8793, or program data is saved in the media.

Before attempting to save the data, make sure that the storage media is inserted and the loading target is correctly specified.

Procedure

To open the screen: press the **FILE** key to display the **[File]** sheet.



CF:\HIOKI_MR8827\

Name △	Type	Date	Time	Size
NOISE	.WFG	15-11-11	15:53:12	5.4KB

Command	Save
Save Type	Arb Waveform
Save Name	INVERTER-U1
Same Name	Auto
Unit No	1
Channel No	1
Name	NONAME

Save Info

Save Type WFG
Save Size 5.4KB

Hint Set the format to save the data.
Text data cannot be read in this instrument.

1 **Press [Next Page].**

2 **Select [Pulse Patt], [Arb Waveform], or [Program].**

3 **Enter a [Save Name].**

4 **Register a [Unit No], a [Channel No], and a [Name] of the MR8791 or the U8793.**

5 **Press [Exec].**
The data registered in the module is saved to the media.

Refer to the instruction manual of Models U8793, MR8790, and MR8791 regarding each detailed save settings.

5.3 Load Data

Data saved on storage media or in the internal memory of the instrument can be reloaded.

Load Data Workflow

Before attempting to load data, make sure that the storage media is inserted and the loading target is correctly specified.

Only settings and measurement data saved in binary format can be loaded on the instrument.

Waveform data

1. Insert the storage media.
2. Select data to be loaded. (Extension: **.MEM**, **.REC**, **.FFT**, **.XYC**, **.IDX**, **.SEQ**)
3. Select **[Load]**
4. Select **[Exec]**
5. Load

Settings data

1. Insert the storage media.
2. Select data to be loaded. (Extension: **.SET**)
3. Select **[Load]**
4. Select **[Exec]**
5. Load

Text comment

1. On Printer sheet, set **[Text Comment]** to **[Before Wave]** (or **[After Wave]**).
2. Insert the storage media.
3. Select data to be loaded. (Extension: **.TXT**)
4. Select **[Load]**
5. Select **[Exec]**
6. Load

Waveform evaluation area

1. Insert the storage media.
2. Select data to be loaded. (Extension: **.ARE**, **.BMP**)
3. Select **[Load]**
4. Select **[Exec]**
5. Load

Waveform output data

1. Insert the storage media.
2. Select data to be loaded. (Extension: **.WFG**, **.TFG**, **.PLS**, **.FGP**)
3. Select **[Load]**
4. Specify the module and channel of the loading target.
5. Select **[Exec]**
6. Load

Refer to See “8.11 Register the Waveform in the U8793 ArbitraryWaveform Generator Unit” (page 191), or the instruction manual of Models U8793, MR8790, and MR8791 regarding the detailed settings for loading (registration) of pulse pattern data, arbitrary waveform data, program data.

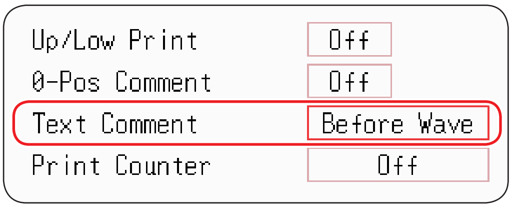
Procedure

Press the **FILE** key to open the File screen.

1 To load a text comment

Press the **SYSTEM** key and bring up the **[Printer]** sheet.

Move the cursor to **[Text Comment]**, and select **[Before Wave]** (or **[After Wave]**).

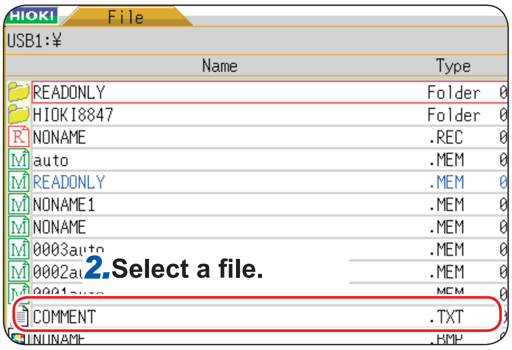


Up/Low Print	Off
0-Pos Comment	Off
Text Comment	Before Wave
Print Counter	Off

2 Select a file.

Use the **CURSOR** keys to select the file to load.
(The file type is indicated by the extension)

Refer to "(Extension)" in the "Load Data Workflow" (p. 99).



USB1:¥

Name	Type
READONLY	Folder
HIOKI8847	Folder
NONAME	.REC
auto	.MEM
READONLY	.MEM
NONAME1	.MEM
NONAME	.MEM
0003auto	.MEM
0002au	.MEM
0001auto	.MEM
COMMENT	.TXT
NONAME	.BMP

3 Carry out the loading operation.

Select **[Exec]**. The file will be loaded.

The name of the loaded file will appear on the screen.

To cancel loading, select **[Cancel]**.

When loading data from the sources other than the internal memory/built-in drive
Insert the storage media before selecting the media.

Other limitations

- Data saved with Memory HiCorders other than the MR8827 cannot be loaded.
- When loading waveform data, the settings for the unit will change to the same settings as when the data was saved. To reset the unit settings, carry out **[Clear Wave Data]** (p. 402) or start measurement.

Batch Load of Waveform Data

When the following index files are loaded, waveform data can be loaded as a batch. With the following settings, index files are created along with waveform files.

Extension	Explanation
IDX	Divided files are loaded together. **(To create index files, use [Division] on the [File Save] sheet of the System screen to set the dividing size before saving. Note: If [Save type] is not [Wave Binary], index files will not be created)** Refer to “5.2.2 Automatically Save Waveforms” (p. 88) or “5.2.3 Save Data Selectively (SAVE Key)” (p. 94).
SEQ	(When using the memory division function of the memory function) Waveform data of all blocks is loaded together. **(To create index files, set [Memory Div] to [On] on the [Memory Div] sheet of the Status Screen, and then, set [Save Type] to [ALL-Wave Bin] on the [File Save] sheet of the System Screen.)** Refer to “12.1 Recording Settings” (p. 247) or “5.2.3 Save Data Selectively (SAVE Key)” (p. 94).

Load a Waveform Evaluation Area

Files with the following two extensions can be loaded:

Extension	Explanation
ARE	**Loads waveform evaluation areas and settings data** **(Files saved by selecting [Area settings] when saving the data).**
BMP	Loads waveform evaluation areas. (Files saved by selecting **[Area image]** when saving the data can be edited on a PC and then loaded back into the instrument.)

Data Loading for Waveform Generation (Registration)

You can load data for generated modules.
Data loading is performed on Signal generator sheet of Channel screen (**CHAN** key) or FILE screen (**FILE** key).
For details, see the instruction manual of Models U8793, MR8790, and MR8791.

Extension	Explanation
WFG, TFG	**Loads waveform evaluation areas and settings data** **(Files saved by selecting [Area settings] when saving the data).** Refer to **“8.11 Register the Waveform in the U8793 ArbitraryWaveform Generator Unit” (p. 191)**
PLS	**The data for pulse pattern generation is loaded in channels of a specified arbitrary wave generator module.** **The pulse pattern waveform loaded (registered) is output from Model MR8791 Pulse Generator Unit.**
FGP	The waveform generation program file is loaded in channels of a specified arbitrary waveform generator module.

5.4 Automatically Load Settings (Auto-setup Function)

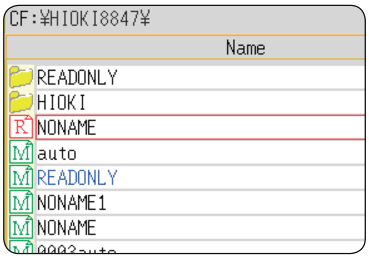
When settings are saved as described below, they can be loaded automatically at power-up.

The auto-setup function is compatible with CF cards only.
If the STARTUP file is on the built-in drive, USB memory stick, or RAM (internal memory), it will not be referenced. Always create the STARTUP file on a CF card.

Procedure

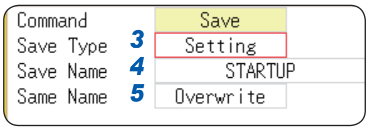
Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)



CF:¥HIOKI8847¥

Name
READONLY
HIOKI
R NONAME
M auto
M READONLY
M NONAME1
M NONAME



Command		Save
Save Type	3	Setting
Save Name	4	STARTUP
Same Name	5	Overwrite

1 **Select [Change Media] and specify the CF card.**

2 **If a folder named “HIOKI_MR8827” exists in the root directory (topmost folder on media), move the cursor to that folder.**

If the folder does not exist, go to the root directory. (A folder named “HIOKI_MR8827” will be created automatically and used as the save location.)

3 **Select [Save] and set [Save Type] to [Setting].**

4 **Move the cursor to [Save Name], and enter “STARTUP.”**
Refer to “8.1.3 Alphanumeric Input” (p. 149).

5 **Move the cursor to [Same Name], and select [Overwrite].**

6 **Select [Exec].**
To cancel setting, select [Cancel].

The next time the instrument is turned on, the settings will be loaded automatically.

5.5 Manage Files

Press the **FILE** key to display the File screen. Data saved to storage media can be managed on the File screen.
Use the **CURSOR** keys to select a file from the file list.

Before performing an operation, insert the storage media (except for the optional built-in drive). When no storage media is inserted, **[NO FILE]** appears in the file list of the File screen.

List of File Operations

Operation key	Function indication (GUI)	Description	Reference page
CH.SET	Media Change	Change storage media.	(p. 84)
F1	Save	Select channels and save settings data and waveform data as files.	(p. 104)
	Sort	Sort the files in the file list in the selected order.	(p. 108)
F2	Open Folder	Open the selected folder.	(p. 106)
	Load	Load settings data or waveform data from a file.	(p. 99)
	Copy	Copy a file to a specified folder. If selected item is a folder, move to that folder.	(p. 110)
F3	New Folder	Create a new folder.	(p. 106)
	Rename	Change a file or folder name.	(p. 109)
F4	Delete	Delete a file or folder.	(p. 107)
	Format	Format selected storage media.	(p. 48)
F5	Next Page	Switch the operations assigned to the **F** keys (GUI).	

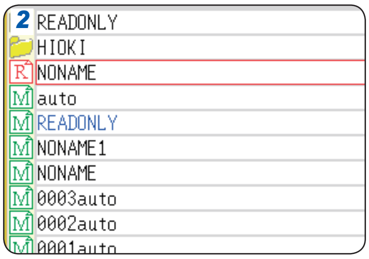
5.5.1 Save Data

You can save settings data, waveform data, or waveform genaration data on storage media. Data will be saved in the folder indicated by the cursor.
By using the AB cursor pair, portions of waveform data can be saved.

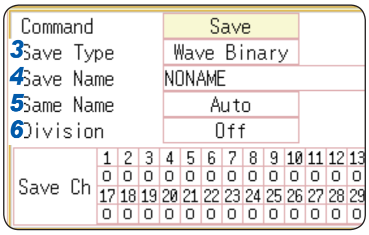
Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)



READONLY
HIOKI
NONAME
auto
READONLY
NONAME1
NONAME
0003auto
0002auto
0001auto



Command: Save
Save Type: Wave Binary
Save Name: NONAME
Same Name: Auto
Division: Off

Save Ch	1	2	3	4	5	6	7	8	9	10	11	12	13
	0	0	0	0	0	0	0	0	0	0	0	0	0
	17	18	19	20	21	22	23	24	25	26	27	28	29
	0	0	0	0	0	0	0	0	0	0	0	0	0

1 **Select storage media.**

Refer to “To Change Media” (p. 84).

2 **Move the cursor to the target folder.**

3 **Set the data to save.**

Select **[Save]** then **[Save Type]**.

Setting	Settings data
Wave Binary	Waveform data (Binary)
Wave Text	Waveform data (Text) (Memory/Recorder/FFT Function)
Numeric value calculation results	Numeric value calculation results (Text)
Waveform evaluation settings	Settings data and evaluation area
Waveform evaluation area	Evaluation area data
Pulse pattern	Pulse pattern data registered in the MR8791*
Arbitrary waveform	Arbitrary waveform data registered in the U8793*
Program	Program data registered in the U8793*

Refer to “5.2.4 Save Waveform Output Data to the Media” (p. 98)

4 **Set the file name.**

Move the cursor to **[Save Name]**.
Enter a file name.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

- The “Text” option is only for loading the data on a PC. Data saved with this option cannot be loaded back into the instrument. To reload the data on the instrument at a later date use the “Binary” option.
- When **[Memory (Int)]** is selected as storage media, only settings data can be saved.
- Waveform evaluation areas can be saved as a black-and-white BMP files.
- Saved data can be edited on a PC and loaded back into the instrument.
- Edit images in black and white only.

5 **Specify the action if a file with the same name exists in the target folder.**

Move the cursor to **[Same Name]**.

Auto	If a file with the same name exists, a 4-digit number is automatically added to the beginning of the file name. If the first character of the file name is a numeral, the added number will continue sequentially from that number.
Serial	Unconditionally, a 4-digit number is automatically added to the beginning of the file name. If a file with the same name exists, saves the file, adding the 4-digit number that is increased by 1.
Overwrite	Saves the file with the designated name.
Error	If a file with the same name exists, an error message will be displayed.

6 **(When the selected save type is [Wave Binary])**

Select whether to save divided files.
Move the cursor to **[Division]**.

Off	Files are not divided when saved.
16M, 32M, 64M	Select the size for Divided Save.

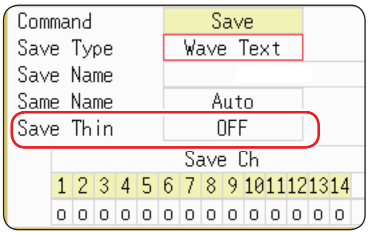
Refer to "About divided saving" (p. 105).

(When the selected save type is [Text])

Set the data thinning amount.

Move the cursor to **[Save Thin]**.

Off	No data thinning (sub-sampling).
1/2 to 1/1000	Set the thinning amount (the fraction of the total data to retain).

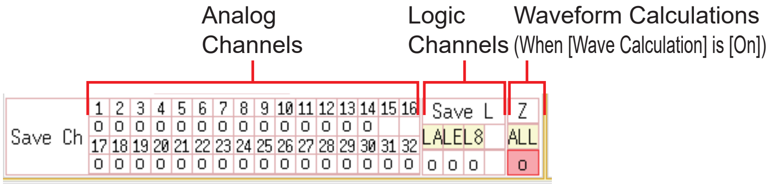


Command Save
Save Type Wave Text
Save Name
Same Name Auto
Save Thin OFF
Save Ch
1 2 3 4 5 6 7 8 9 10 11 12 13 14
○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

When saving settings data, a settings file for automatic loading of settings can be created as follows: specify the folder **[HIOKI_MR8827]** on the CF card as the save location folder and use **[STARTUP]** as **[Save Name]**.
Refer to "5.4 Automatically Load Settings (Auto-setup Function)" (p. 102).

7 **Select the channels to save.**

Move the cursor to **[Save Ch]**.



Save Ch
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Save L Z
○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 LALEL8 ALL
○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

Cells for channels of logic modules or generator modules are left blank.

—	Channel will not be saved.
○	Channel will be saved.
All Ch	Saves waveforms acquired across all channels (analog, logic, calculated waveforms).
Reset	Return to previous settings.

8 **Execute the save operation.**

Select [Exec].

To cancel saving, select [Cancel].

File name
The maximum number of characters for **[Save Name]** is 123. The maximum path length including file name is 255 characters.

About divided saving
- Large quantities of waveform data can be divided and saved as multiple files if necessary.
- Saving divided data creates one or more waveform files and an index (IDX) file.
- Then by loading the IDX file, the data in the waveform file(s) is loaded as a batch.
  Refer to "Batch Load of Waveform Data" (p. 101).
- Each file can be loaded as a separate waveform data file.

Other limitations
Text format data cannot be loaded on the instrument.

5.5.2 Check the Contents of a Folder (Open a Folder)

Opening a folder allows you to inspect its contents. (Moves to the folder.)

Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)

1 **Move the cursor to the folder whose contents you want to see.**

2 **Select [Open Folder] or press the Right CURSOR key.**

A list with the folder contents will be displayed.

To return to a higher folder

Press the **Left CURSOR** key.

5.5.3 Create New Folders

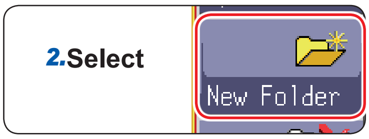
You can create a new folder in the currently displayed folder level.

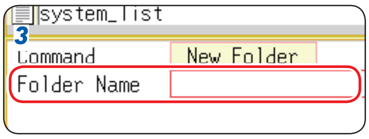
Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)

1 **Navigate to the folder level where you want to create a new folder.**





Command New Folder

Folder Name

2 **Select [New Folder].**

3 **Enter [Folder Name].**

Refer to “8.1 Add Comments” (p. 146).

4 **Select [Exec].**

A new folder will be created.

To cancel creating folder, select [Cancel].

Folder name

The maximum number of characters for **[Save Name]** is 127. The maximum path length including folder name is 255 characters.

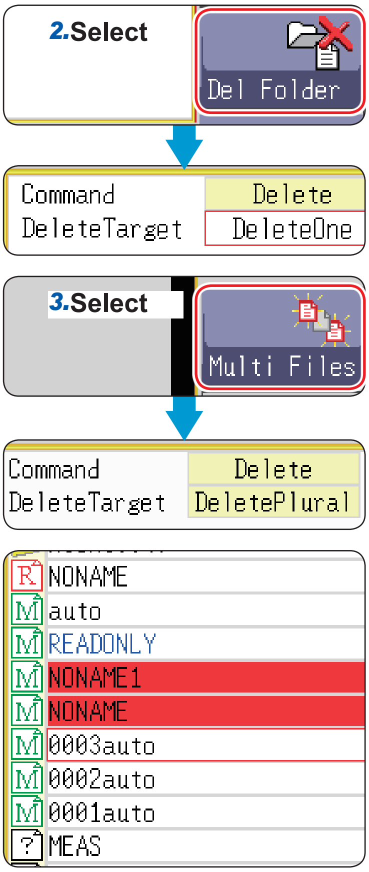
5.5.4 Delete Files and Folders

Follow this procedure when you need to delete files or folders from your Memory HiCorder.

Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)



Command Delete
DeleteTarget DeleteOne

Command Delete
DeleteTarget DeletePlural

1 **Select the file or folder you want to delete.**

2 **Select [Del Folder].**

[DeleteTarget] displays [DeleteOne].

3 **(When multiple files are to be deleted)**

Select [Multi Files].

[DeleteTarget] displays [DeletePlural].

Slct/Deslct	Select the individual file or folder at the cursor. If something is currently selected, the selection will be cleared.
Slct/Deslct All	Select all files or folders. If something is currently selected, the selection will be cleared.
Rev Slct	Currently selected files or folders will be deselected, and currently unselected files or folders will be selected.

Selected files or folders are shown in red (see illustration at right).

4 **Select [Exec].**

The selected files or folders will be deleted.

To cancel deletion, select [Cancel].

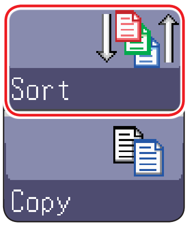
5.5.5 Sort Files

You can change the sort type and order of the file list.

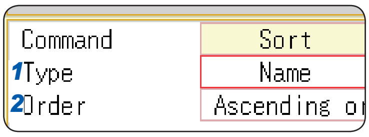
Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)



1 **Select**



Command	Sort
1 Type	Name
2 Order	Ascending o

1 Select [Sort] then select [Type].

Off	No sorting.
Name	Sorts files alphabetically by file name.
Type	Sorts files by type of data (settings, MEM waveforms, etc.)
Date	Sorts files by creation date and time.
Size	Sorts files by size.

2 Move the cursor to [Order].

Ascending order	A → Z → , Old → New, Small → Large
Descending order	Reverse sort order

Folders/files will be sorted in the specified order.

3 Select [OK].

The sort screen will close.

The order format will be displayed in the file list (with △: Ascending order; ▽: Descending order mark) and indicated in the GUI. When there are both files and folders, folders are listed at the top and files at the bottom.

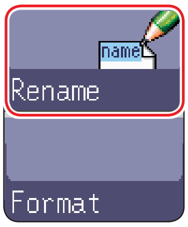
5.5.6 Rename Files and Folders

Follow this procedure when you want to rename a file or folder.

Procedure

Press the **FILE** key to open the File screen.

To change the storage media: (p. 84)

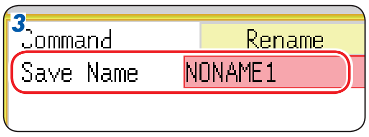


2.Select

1 **Select the file or folder you want to rename.**

2 **Select [Rename].**

3 **Select [Enter Char], and enter [Save Name].**
Refer to “8.1 Add Comments” (p. 146).



Command Rename
Save Name NONAME1

4 **Select [Exec].**
The file or folder will be renamed.

To cancel renaming, select [Cancel].

5.5.7 Copy a File Into a Specified Folder

This function allows to organize your files by copying files into specified folders.

Procedure

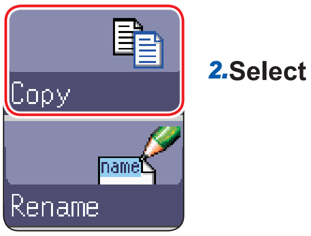
Press the **FILE** key to open the File screen.

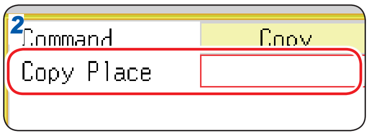
To change the storage media: (p. 84)

1 **Move the cursor to the file you want to copy.**

2 **Select [Copy].**

Move the cursor to **[Copy Place]**.

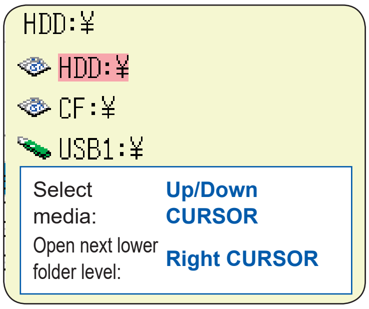




3 **Select [Edit].**

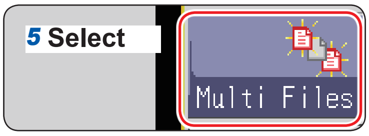
The Browse folders dialog box appears (at bottom right).

4 **Move the cursor to the target folder and confirm the setting with [Confirm].**


HDD:¥
HDD:¥
CF:¥
USB1:¥
Select media: Up/Down CURSOR
Open next lower folder level: Right CURSOR

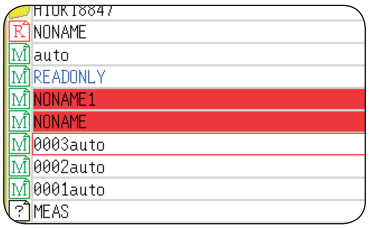
5 **(When there are multiple copy targets)**

Select [Multi Files].



Slct/Deslct	Select the individual file or folder at the cursor. If something is currently selected, the selection will be cleared.
Slct/Deslct All	Select all files or folders. If something is currently selected, the selection will be cleared.
Rev Slct	Currently selected files or folders will be deselected, and currently unselected files or folders will be selected.

Selected files or folders are shown in red (see illustration at right).



Select [Select End].

6 **Select [Exec].**

The file(s) will be copied to the specified target location.

To cancel copying, select [Cancel].

5.5.8 Print the File List

The file list of the File screen can be printed. Details for all displayed items in the file list will print. Only folder names are printed for folders. Information on the contents of folders is not printed.

Before printing, make sure the recording paper is loaded correctly.
Refer to “2.4 Load Instrument With Recording Paper (When Model U8350 Printer Unit is installed)” (p. 49).

Procedure

Press the **FILE** key to open the screen → File screen

To change the storage media: (p. 84)

Press the PRINT key.

The file list will print.

To cancel printing before it has finished:

Press the **STOP** key.

The file list will print as shown below.

Print Example

```
No.   File Name  Type   Date               Size      Attribute
-------------------------------------------------------------
1     0001AUTO   MEM    14-06-16 00:00:00  21kB      [   ]
2     0002AUTO   MEM    14-06-16 00:01:00  21kB      [   ]
.
.
.
```

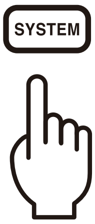
File attributes are represented by single letters according to the table below.

R	For Loading only
H	Hidden File
S	System File
D	Folder
A	Archive (Backup)

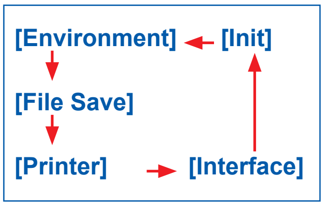
6 Printing (When Model U8350 Printer Unit is installed)

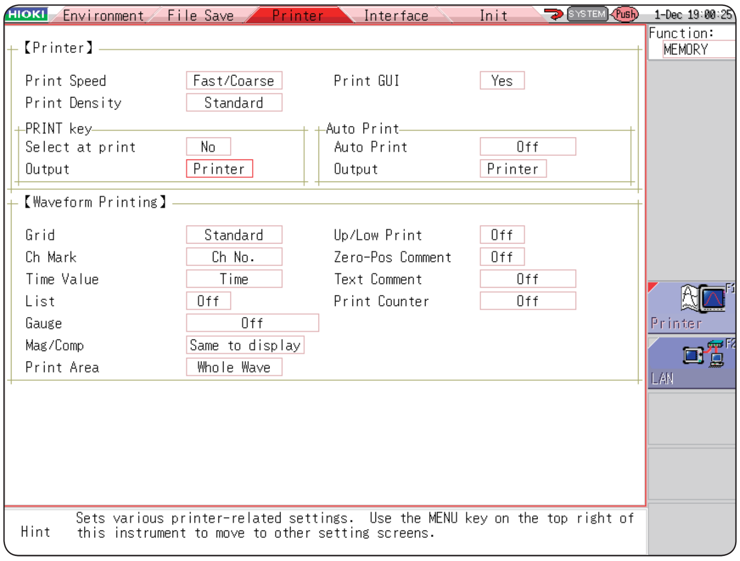
The **[Printer]** sheet lets you set the print method and detailed printer options.

To Open the [Printer] Sheet



Press this key repeatedly to display the various sheets.





【Printer】

Print Speed	Fast/Coarse	Print GUI	Yes
Print Density	Standard		

PRINT key

Select at print	No
Output	Printer

Auto Print

Auto Print	Off
Output	Printer

【Waveform Printing】

Grid	Standard	Up/Low Print	Off
Ch Mark	Ch No.	Zero-Pos Comment	Off
Time Value	Time	Text Comment	Off
List	Off	Print Counter	Off
Gauge	Off		
Mag/Comp	Same to display		
Print Area	Whole Wave		

Hint Sets various printer-related settings. Use the MENU key on the top right of this instrument to move to other setting screens.

Operations available from the [Printer] sheet

To select the print method

Refer to “6.1 Print Type and Workflow” (p. 114).
- Auto-print (p. 115)
- Manual Print (p. 118)

Refer to “6.6.1 Screen Hard Copy” (p. 124).
Refer to “6.6.2 Report Print (A4 Size Print)” (p. 124).
Refer to “6.6.3 List Print” (p. 125).
Refer to “6.6.4 Text Comment Printing” (p. 125).

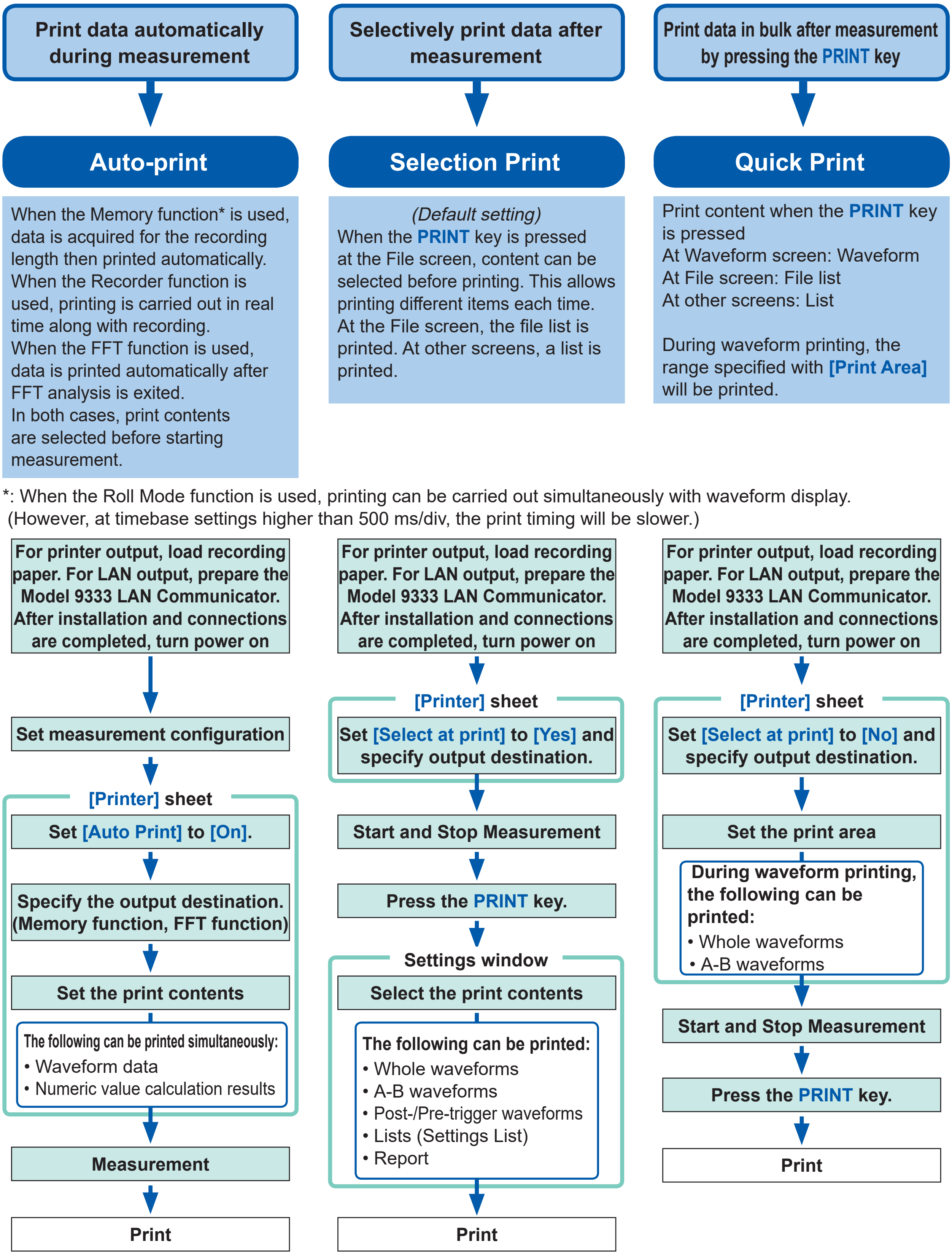
Printer settings

- Print Speed (p. 121)
- Grid Type (p. 121)
- Channel Marker Type (p. 121)
- List (p. 122)
- Gauge (p. 122)
- Printer Density (p. 121)
- Horizontal axis (Time axis) Zoom (Mag/Comp) (p. 122)
- Upper/Lower Limit Print (p. 123)
- Zero Position Comment Print (p. 123)
- Print Counter (p. 123)

- As much as possible, avoid printing in hot and humid environments. Otherwise, printer life may be severely shortened.
- When solid (100% black) printing is continued for a long time, the print head may become hot, resulting in smeared printing. In such a case, stop printing for a while until the print head cools.

6.1 Print Type and Workflow

There are three basic types of printing.



Print data automatically during measurement

Auto-print

When the Memory function* is used, data is acquired for the recording length then printed automatically.
When the Recorder function is used, printing is carried out in real time along with recording.
When the FFT function is used, data is printed automatically after FFT analysis is exited.
In both cases, print contents are selected before starting measurement.

For printer output, load recording paper. For LAN output, prepare the Model 9333 LAN Communicator. After installation and connections are completed, turn power on

Set measurement configuration

[Printer] sheet

Set [Auto Print] to [On].

Specify the output destination. (Memory function, FFT function)

Set the print contents

The following can be printed simultaneously:
- Waveform data
- Numeric value calculation results

Measurement

Print

Selectively print data after measurement

Selection Print

(Default setting)
When the **PRINT** key is pressed at the File screen, content can be selected before printing. This allows printing different items each time. At the File screen, the file list is printed. At other screens, a list is printed.

For printer output, load recording paper. For LAN output, prepare the Model 9333 LAN Communicator. After installation and connections are completed, turn power on

[Printer] sheet

Set [Select at print] to [Yes] and specify output destination.

Start and Stop Measurement

Press the PRINT key.

Settings window

Select the print contents

The following can be printed:
- Whole waveforms
- A-B waveforms
- Post-/Pre-trigger waveforms
- Lists (Settings List)
- Report

Print

Print data in bulk after measurement by pressing the PRINT key

Quick Print

Print content when the **PRINT** key is pressed
At Waveform screen: Waveform
At File screen: File list
At other screens: List

During waveform printing, the range specified with **[Print Area]** will be printed.

For printer output, load recording paper. For LAN output, prepare the Model 9333 LAN Communicator. After installation and connections are completed, turn power on

[Printer] sheet

Set [Select at print] to [No] and specify output destination.

Set the print area

During waveform printing, the following can be printed:
- Whole waveforms
- A-B waveforms

Start and Stop Measurement

Press the PRINT key.

Print

*: When the Roll Mode function is used, printing can be carried out simultaneously with waveform display. (However, at timebase settings higher than 500 ms/div, the print timing will be slower.)

When both auto-print and auto-save are enabled, auto-save is executed first.
However, when the Roll Mode function (default setting: **[Auto]**) is used with the Memory function, auto-print has priority.

6.2 Auto-print Settings

MEM **REC** **X–Y**

This applies to the Memory, Recorder, and FFT functions.
These settings must be set before starting measurement.
Measurement data will print automatically when you press the **START** key to start measurement. For printer output, make sure that the recording paper is loaded correctly. For LAN output, make sure that the PC connected via LAN is prepared.

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Printer]** sheet.

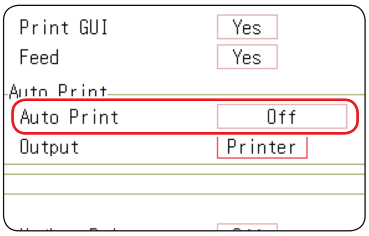
1 **Enable auto-print.**

(When using the Memory or FFT Functions)

Move the cursor to **[Auto Print]**, and select **[On]**.

Default setting: Off (no automatic printing)

(When using the Recorder Function)
Move the cursor to **[Realtime Print]**.
Select **[On]**.



Print GUI	Yes
Feed	Yes
Auto Print	
Auto Print	Off
Output	Printer

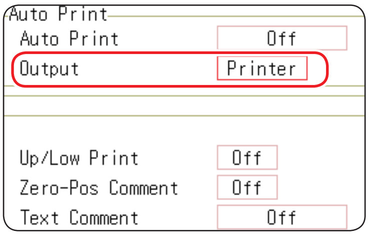
2 **(When using the Memory or FFT Functions)**

Specify the output destination.

Move the cursor to **[Output]**.

Printer:
LAN: The data is automatically output to the PC connected via LAN.
Model 9333 LAN Communicator required.

Printer	The data is automatically printed by the internal printer. (*Default setting*)
LAN:	The data is automatically output to the PC connected via LAN. Model 9333 LAN Communicator required.



Auto Print	
Auto Print	Off
Output	Printer
Up/Low Print	Off
Zero-Pos Comment	Off
Text Comment	Off

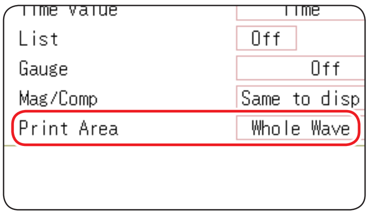
3 **(When using the Memory Function)**

Choose print area settings as required.

Move the cursor to the **[Print Area]** item.

Whole Wave	Print all waveform data in internal memory of the unit. (*Default setting*)
A-B Wave	Print only A and B cursors defined range of waveform data in the internal memory of the unit.

With the Recorder function, the whole waveform will be printed during measurement regardless of the print area setting.

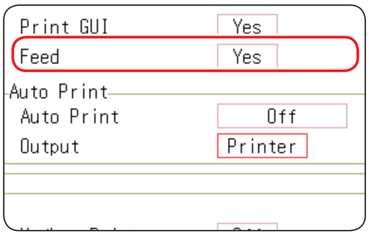


Time Value	Time
List	Off
Gauge	Off
Mag/Comp	Same to disp
Print Area	Whole Wave

- **To output waveform data to the PC connected via LAN**
  Model 9333 LAN Communicator must be installed on the PC to which the data is to be output.
  For more information about how to operate and configure the Model 9333 LAN Communicator, as well as install it on a PC, see the instruction manual of Model 9333 LAN Communicator.
- **When setting the output destination to [LAN]**
  The IP addresses of the instrument and the PC connected via LAN must be set. For more information about how to set the IP addresses, refer to (p. 318).

4 Set the margins in automatic print

Move the cursor to the [Feed].



Print GUI Yes
Feed Yes
Auto Print
Auto Print Off
Output Printer

Yes	Margin (Default setting)
No	No margins*

* There is a margin of about 2 mm.
[Feed] are also applicable to normal printing.

5 Check the measurement conditions and start the measurement.

(Press the START key.)

When using the Memory Function
Data is acquired for the recording length then printed automatically.

When using the Recorder Function
Printing is carried out in real time along with recording.

When using the FFT Function
Data is printed automatically after FFT analysis finishes.

To stop printing before it has finished
Press the **STOP** key. Measurement will also stop.

Printing can be paused and restarted using the F key during Real-Time Printing (Recorder Function).
Move the cursor to the [Realtime Print] item, and select On or Off.
When printing is carried out again after stopping, the range selection will be used.

- When both auto-print and auto-save are enabled, auto-save is executed first.
  However, when the Roll Mode function (default setting: [Auto]) is used with the Memory function, auto-print has priority.
- If AB cursors are on during manual printing after acquiring waveform data, the selected range will be printed.

Timebase (Time/div)	Measurement conditions	Printing
Up to 200 ms/div	Memory Function (Roll Mode: Off)	Data is acquired for the recording length then printed automatically
	Memory Function (Roll Mode: On) Recorder Function (Recording length: Other than Continuous [Cont.])	Print simultaneously with some delay from recording.
	Recorder Function (Recording length: Continuous [Cont.])	Printing disabled
More than 500 ms/div	Memory Function (Roll Mode: Off)	Data is acquired for the recording length then printed automatically
	Memory Function (Roll Mode: On) Recorder Function	Print simultaneously with recording.

When performing waveform evaluation, the evaluation area will be printed at the same time.
To disable printing of the evaluation area, set waveform evaluation to [Off]. (p. 304)
If [Output] is set to [LAN], realtime printing is disabled. The Auto Print prints automatically after data is acquired for the recording length regardless of the timebase setting.

Simultaneous Printing of Numerical Calculation Results

From the Status screen, select the **[Num Calc]** sheet and set **[Print Calc Result]** to **[On]**.

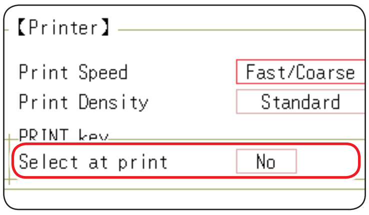
Refer to “10.5 Print Numerical Calculation Results” (p. 229).

6.3 Manual Printing With the PRINT Key (Selective Printing)

Using the **PRINT** key from the Waveform screen, you can specify a printing range and data type.
This can help prevent inadvertent printing due to operator error.

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Printer]** sheet.



【Printer】

Print Speed Fast/Coarse
Print Density Standard
PRINT key
Select at print No

1 **Enable data selection at time of printing**

Move the cursor to **[Select at print]**.
Select **[Yes]**.

2 **Specify the output destination.**

Move the cursor to **[Output]**.

Printer	The data is automatically printed by the internal printer. (*Default setting*)
LAN	The data is automatically output to the PC connected via LAN. Model 9333 LAN Communicator required.The data is automatically output to the PC connected via LAN. Model 9333 LAN Communicator required.

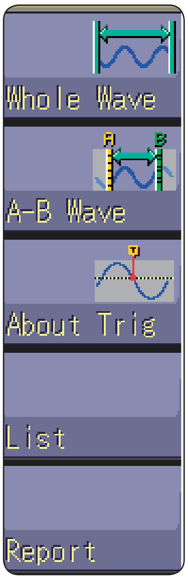
3 Start and stop the measurement.

Press the **START** key to start measurement.
Press the **STOP** key to stop measurement.

Printing is not possible during measurement. Measurement must be stopped before printing is started.

4 Select print contents and execute printing

When you press the **PRINT** key, the “Exec Select print” GUI appears on the right side of the screen.



Whole Wave	Print all waveform data in internal memory of the unit. (*Default setting*)
A-B Wave	Print only A and B cursors defined range of waveform data in the internal memory of the unit. (Memory/ Recorder Function only)
About Trig	Print waveform data for 10 divisions before and after trigger position. (Memory Function only)
List	Print main settings.
Report	Print the report. Refer to “6.6.2 Report Print (A4 Size Print)” (p. 124).

When the selection (except for [Cancel]) has been made, printing starts.

To stop printing before it has finished, press the **STOP** key.

When performing waveform evaluation, the evaluation area will be printed at the same time. To disable printing of the evaluation area, set waveform evaluation to **[Off]**. (p. 304)

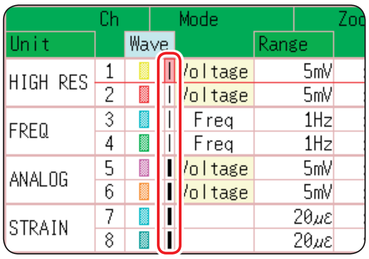
- **To output waveform data to the PC connected via LAN**
  Model 9333 LAN Communicator must be installed on the PC to which the data is to be output.
  For more information about how to operate and configure the Model 9333 LAN Communicator, as well as install it on a PC, see the instruction manual of Model 9333 LAN Communicator.
- **When setting the output destination to [LAN]**
  The IP addresses of the instrument and the PC connected via LAN must be set. For more information about how to set the IP addresses, refer to (p. 318).

6.4 Setting the Print Density of the Waveform

The printing density of the waveform can be set for each channel.

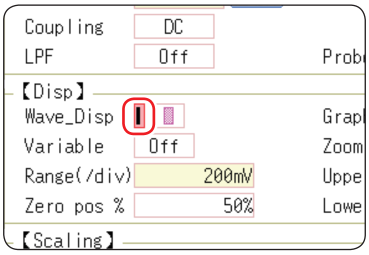
Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Unit List]** sheet or **[Each Ch]** sheet.



Unit	Ch	Wave		Mode	Range
HIGH RES	1		|	Voltage	5mV
	2		|	Voltage	5mV
FREQ	3		|	Freq	1Hz
	4		|	Freq	1Hz
ANALOG	5		▌	Voltage	5mV
	6		▌	Voltage	5mV
STRAIN	7		▌		20με
	8		▌		20με

[Unit List] sheet



Coupling DC
LPF Off
【Disp】
Wave_Disp ▌
Variable Off
Range(/div) 200mV
Zero pos % 50%
【Scaling】

[Each Ch] sheet

Move the cursor to the [Wave] or [Wave_Disp].

Light, Midlight Standard (*Default setting*), Middark, Dark

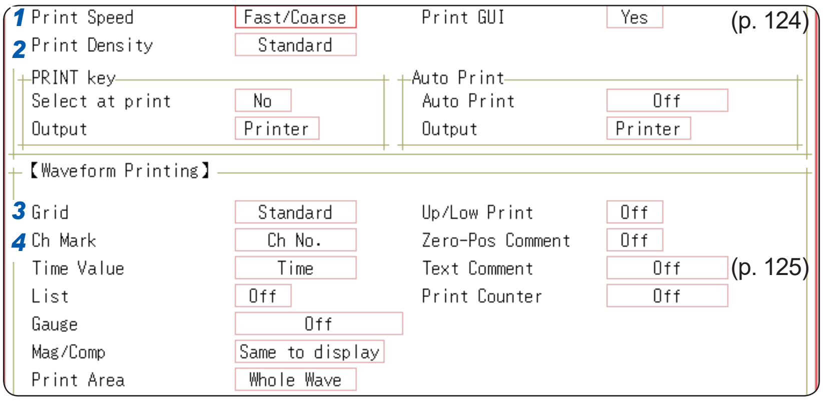
When the waveform print density is Light, a temporary drop in power voltage (for example, a momentary power failure) during printing may cause the print to fail.

6.5 Printer Settings

Choose settings on the **[Printer]** sheet of the System screen.

Printer Settings

To open the screen, press the **SYSTEM** key → **[Printer]** sheet



1 Print Speed: Fast/Coarse — Print GUI: Yes (p. 124)
2 Print Density: Standard

PRINT key
Select at print: No
Output: Printer

Auto Print
Auto Print: Off
Output: Printer

【Waveform Printing】
3 Grid: Standard — Up/Low Print: Off
4 Ch Mark: Ch No. — Zero-Pos Comment: Off
Time Value: Time — Text Comment: Off (p. 125)
List: Off — Print Counter: Off
Gauge: Off
Mag/Comp: Same to display
Print Area: Whole Wave

1 **Select the print speed (quality).**

Move the cursor to **[Print Speed]**.

Fast/Coarse (*Default setting*), Normal, Slow/Fine

2 **Select the printer density.**

Move the cursor to **[Printer Density]**.

Light, Midlight, Standard (*Default setting*), Middark, Dark

3 **Select the grid type.**

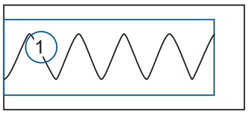
Move the cursor to **[Grid]**.

Off, Standard (*Default setting*), Fine, Std Dark, Fine Dark

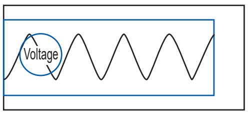
4 **Select the channel marker type.**

Move the cursor to **[Ch Mark]**.

<Print Example>



Channel number



Comment

Off	Do not print the channel number or comments.
Ch No.	Print the channel number. *(Default setting)*
Comment	Print the comments entered in the Channel Settings screen over the waveform. A comment must have been set. Refer to “8.1 Add Comments” (p. 146).

Grid Type

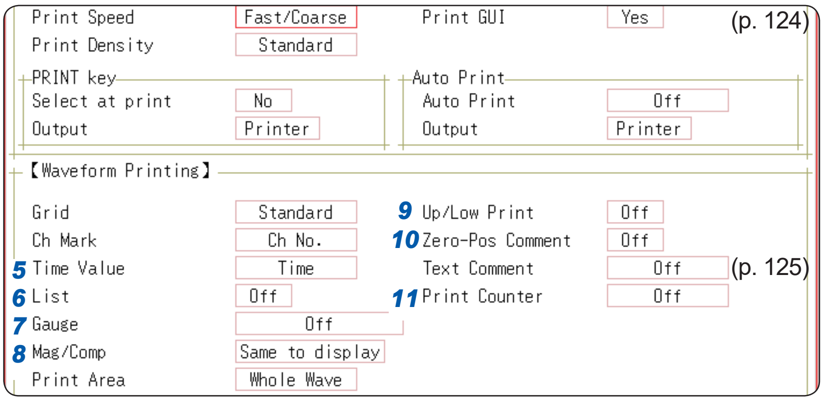
Grids displayed on the screen are not reflected in the printout.

Print Speed

When **[USB Set]** is set to **[Mass Storage HDD]** or **[Mass Storage CF]**, printing speed is always **[Slow/Fine]**.

When the instrument is configured to automatically save data to USB memory, automatic printing will be performed at **[Normal]** speed, even if the print speed has been set to **[Fast]**.

The **[Fast/Coarse]** setting has the maximum print speed of 50 mm/s; **[Normal]**, 20 mm/s; and **[Slow/Fine]**, 10 mm/s. The speed, however, depends on printing conditions.



Print Speed Fast/Coarse
Print GUI Yes (p. 124)
Print Density Standard

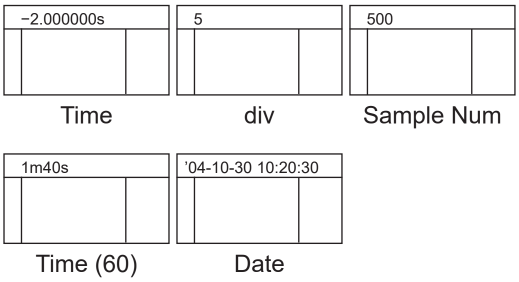
PRINT key
Select at print No
Output Printer

Auto Print
Auto Print Off
Output Printer

【Waveform Printing】
Grid Standard
Ch Mark Ch No.
5 Time Value Time
6 List Off
7 Gauge Off
8 Mag/Comp Same to display
Print Area Whole Wave
9 Up/Low Print Off
10 Zero-Pos Comment Off
Text Comment Off (p. 125)
11 Print Counter Off

5 Select the horizontal axis (time axis) display value.

Move the cursor to **[Time Value]**.
<Print Example>



Time*	Print the time from trigger event (unit is fixed). *(Default setting)*
Time (60)*	Print the time from trigger event (sexagesimal (base-60) system).
div	Print the number of divisions from trigger event.
Date*	Print the date and time when waveform was acquired.
Sample Num	Print the number of samples from trigger event.

* Printing for external sampling is done according to the [Sample Num] setting.

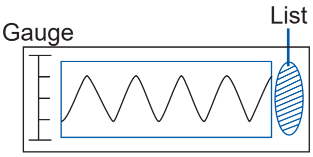
6 Print a list of settings

Move the cursor to the **[List]** item.

Off	Do not print a list. (*Default setting*)
On	Print list after waveform.

7 Select the type of gauge.

Move the cursor to **[Gauge]**.
<Print Example>



Off	Do not print a gauge. *(Default setting)*
Before Wave	Print gauge before waveform.
After Wave	Print gauge after waveform.
Before&Aft Wave	Print gauge before and after waveform.

8 Set the horizontal axis (time axis) magnification and compression.

Move the cursor to **[Mag/Comp]**.

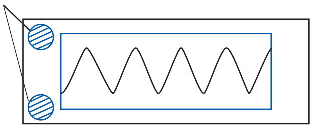
Horizontal axis (Time axis) zoom
When time axis zoom has been set, printing will be carried out using this zoom setting, regardless of the zoom setting on the Waveform screen.

×10 to ×1/200000 (When using the Memory Function) ×1 to ×1/50000 (When using the Recorder Function)	Print using the magnification or compression ratio set here.
Same to display	Print using the magnification or compression ratio set for the waveform screen. (*Default setting*)

9 Set the upper and lower limit value

Move the cursor to **[Up/Low Print]**.

<Print Example>

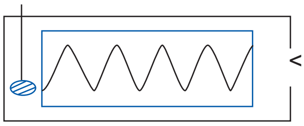


Off	Do not print upper and lower limits. (*Default setting*)
On	Print upper and lower limits.

10 Set the zero-position comment

Move the cursor to **[Zero-Pos Comment]**.

<Print Example>



Off	Print the channel number. (*Default setting*)
On	Print zero position comment.

- The comment is not printed for X-Y display or FFT.
- The zero-position comment is not printed when the comment has not been set.

<Print Example> “8.1 Add Comments” (p. 146).

11 Select the counter print.

Move the cursor to **[Print Counter]**.

Off	Do not print a counter. (*Default setting*)
Date	Print the date of printing and the waveform acquisition count. (Example: 04-8-1-0001)
Name	Print the counter name and the waveform acquisition count. (Example: Device A-0001)

(When [Date] or [Name] is selected)

If you want to begin from an arbitrary count

Move the cursor to **[Counter Num]**, and set an arbitrary count.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

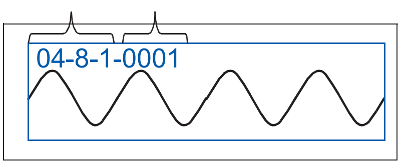
The count is automatically cleared to zero when the instrument is powered on.
The count is increased by 1 each time a waveform is acquired. (Maximum count 9999)

(When [Name] is selected)

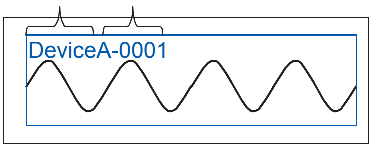
Enter a counter name.

Move the cursor to **[Counter Name]**, and enter a counter name (up to 10 characters).
Refer to “8.1.3 Alphanumeric Input” (p. 149).

<Example of Data and Counter>



<Example of Counter name and Counter>



6.6 Miscellaneous Printing Functions

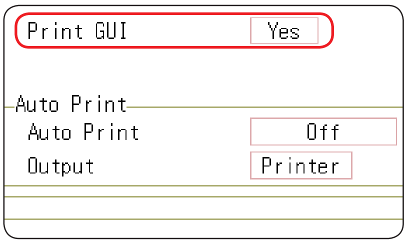
You can print a hard copy of the screen display, reports, or lists.

6.6.1 Screen Hard Copy

Press **COPY** key while the screen you want to is displayed. The printer will produce a hard copy of the screen contents.
The GUI section can also be included in the print.

GUI Print Setting

Press the **SYSTEM** key to open the System screen, and then select the **[Printer]** sheet.



Print GUI: Yes

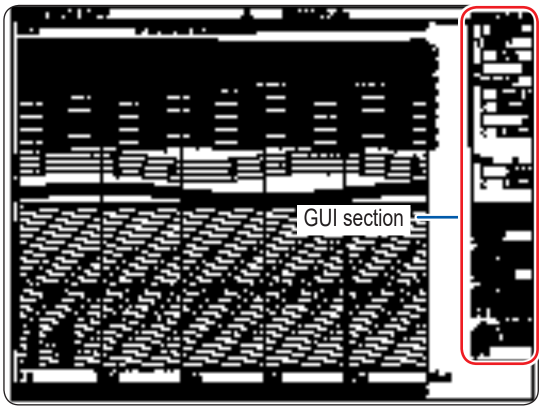
Auto Print

Auto Print: Off

Output: Printer

Set [Print GUI] to [Yes].

To stop printing before it has finished, press the **STOP** key.



6.6.2 Report Print (A4 Size Print)

The waveform range as displayed on the Waveform screen, upper and lower limit values, and channel settings are printed in A4 size. When zoom display is enabled, two zoom display screens are printed.
The AB cursor pair shown on the Waveform screen is also printed.
If the comment type is set to **[Comment]** or **[Set&Com]** on the **[Comment]** sheet of the Channel screen, the title comment can also be printed.
Refer to "8.1.1 Add a Title Comment" (p. 146).

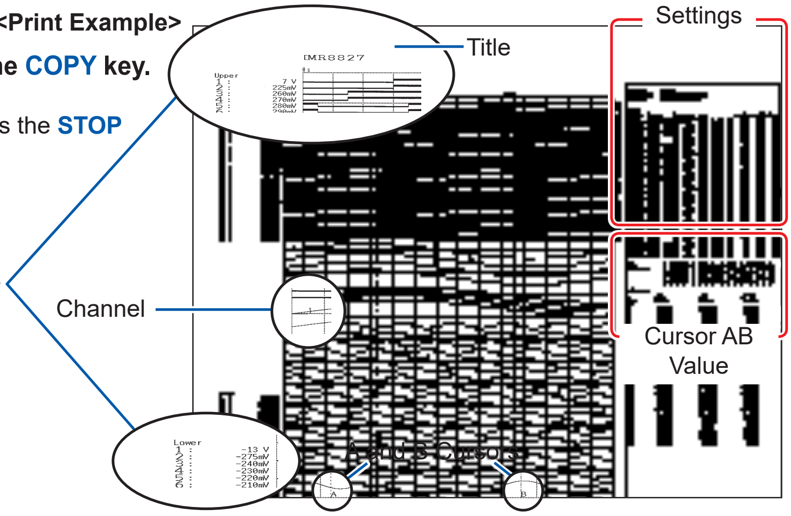
Procedure

Press the **DISP** key to open the screen → Waveform screen, Press the **DISP** key → Display Menu, Select the **[WAVE WIDTH]** menu

Hold down the FEED key and press the COPY key.

To stop printing before it has finished, press the **STOP** key.

<Print Example>



6.6.3 List Print

This function prints out function status information and channel setting information in list format.
The list settings are the same as for the List function.
Refer to “Print a list of settings” (p. 122).

Press the **PRINT** key at a screen other than the Waveform screen.

To stop printing before it has finished, press the **STOP** key.

The printed list contains the setting parameters for the acquired waveform data. The list content will not change even if the settings were changed after the waveform data was acquired.

6.6.4 Text Comment Printing

A text document edited on a PC can be printed together with a waveform.

1 **Create a text file using [Notepad] or another suitable application on the PC.**
The maximum size of the text comment that can be imported to the instrument is 104 × 200.
Print width will be adjusted to the widest line.

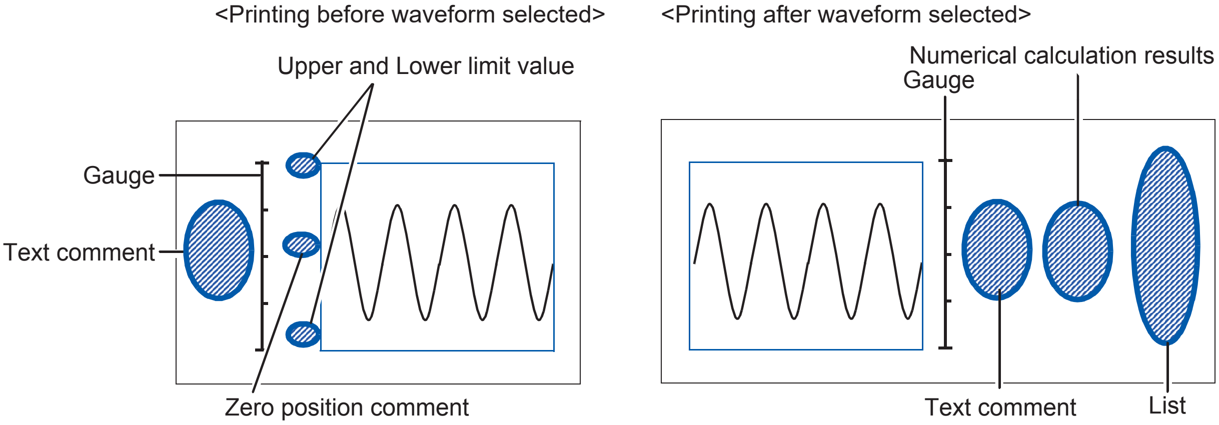
2 **Press the SYSTEM key and set [Text Comment] on the [Printer] sheet.**

Off	Text comment is not printed. (*Default setting*)
Before Wave	Text comment is printed before waveform.
After Wave	Text comment is printed after waveform.

3 **Press the FILE key and use the File screen to import the text file created on the PC into the instrument.**
Refer to “5.3 Load Data” (p. 99).

The text file content will be printed along with the waveform when printing.

Print Example: Positioning with regard to other print items

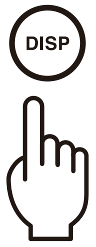


<Printing before waveform selected> <Printing after waveform selected>

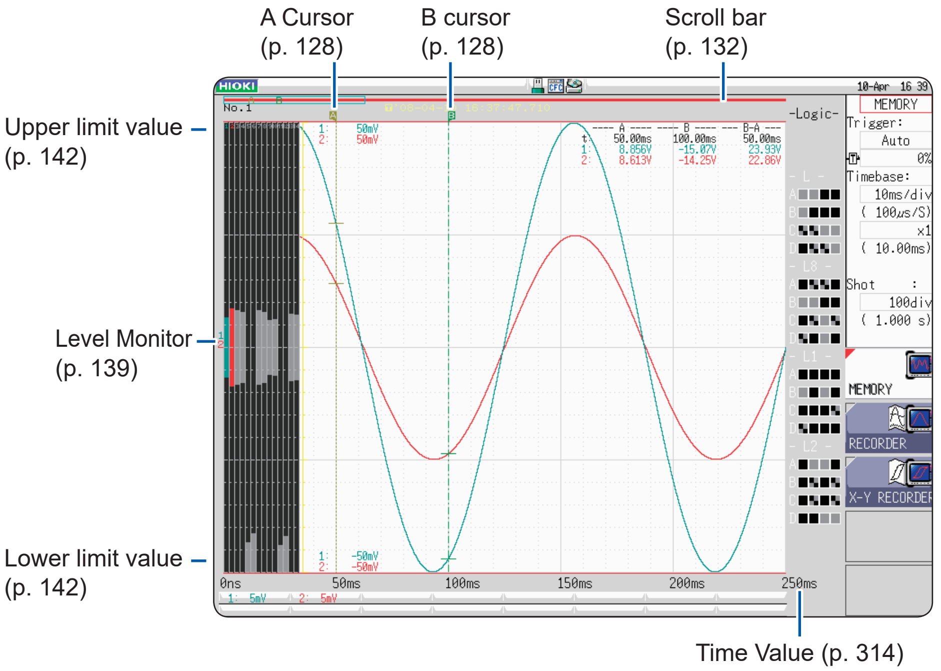
7 Waveform Screen Monitoring and Analysis

Analytical operations such as display magnification, compression, and search are available on the Waveform screen. The measurement condition or other configuration can also be changed on this screen.

To Open the Waveform Screen



Press this key.



Operations available from the Waveform screen

AB Cursor
- Read measurement value (p. 128)
- Specify a waveform range (p. 131)

Move the Waveform Display Position
- Use the jog and shuttle knobs (p. 132)
- Move the position (p. 133)

Perform X-Y Synthesis (p. 134)

Magnify and Compress Waveforms
- Magnify and Compress Horizontal Axis (Time Axis) (p. 136)
- Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis))(p. 137)
- Magnify and Compress Vertical Axis (Voltage Axis) (p. 138)

Monitor Input Levels (p. 139)

Switch the Waveform Screen (p. 141)
- Display upper and lower limit values
- Display comments
- Switch the waveform display width

7.1 Read Measurement Values (Using the AB Cursors)

- Time difference, frequency and potential difference (and when scaling is enabled, scaling values) can be read as numerical values using the AB cursors on the Waveform screen. The cursors also allow you to specify the calculation and print X-Y synthesis range.
- When displaying the X-Y waveform, the AB cursors can be used to read measurement values. Also with a split screen, AB cursors can be used separately in the graphs to read the potential difference between the A and B points.

AB Cursor Settings

Press the **DISP** key to open the Waveform screen, and then press the **AB CSR** key to open the A/B cursors settings window.

1 **Select the Cursor Type.**

Move the cursor to **[AB Cursors]**.

Off	AB cursors are not used.
div	Move in horizontal axis (time axis) direction (X axis for X-Y synthesis)
Range	Move in vertical axis (voltage axis) direction (Y axis for X-Y synthesis)
Trace	Trace waveform data.

2 **Select the movement target for the AB cursors**

Move the cursor to **[Kind]**.

A	Use only cursor A.
A-b	Use AB cursors but move only cursor A.
a-B	Use AB cursors but move only cursor B.
A&B	Move both cursor A and B together.

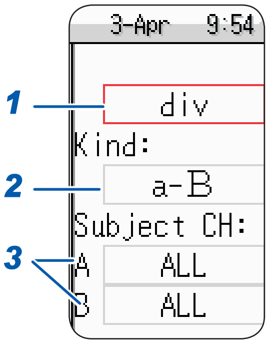
3 **Select the measurement target channel ([Subject CH]) for A and B**

Move the cursor to **[A]** and **[B]**.

ALL	Shows measurement values for all channels. (When cursor type is [Trace] or [Range])
Ch1 to Ch32	Show measurement values in selected channels out of CH1 to CH32 (for 1, 2, 4, 8 screens).
Gr1 to Gr8	Specify X-Y synthesis for Gr1 to Gr8 (for X-Y screen)
Analog Ch↔Calc Ch	When there is data on which waveform calculation has been performed, the cursor target switches between analog channel and waveform calculation data.

4 **Move the AB cursors with the jog and shuttle knobs.**

(While the **AB CSR** key is lit, the cursors can be moved with the jog and shuttle knobs. Pressing a key other than the **AB CSR** key closes the setup screen.)



3-Apr 9:54
div
Kind:
a-B
Subject CH:
A ALL
B ALL

If numerical values are hard to read

Press the **DISP** key to display the waveform and measurement values separately.
Refer to "7.7.3 Switch the Waveform Display Width" (p. 142).

If AB cursors are activated but are not visible on screen

The position of the AB cursors can be checked on the scroll bar. (p. 132)
Turning the jog and shuttle knobs will show the respective cursor on the screen.
If the cursor type is **[div]** or **[Trace]**, cursor measurements can be made even if the A or B cursor is off-screen.

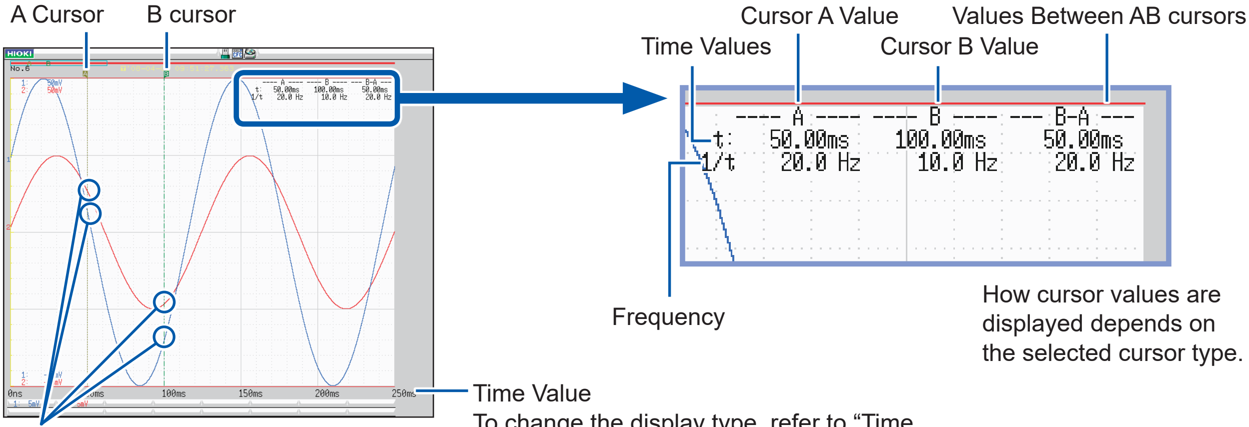
To view the waveform before or after the AB cursors when they are off the screen

When using the AB cursors, the waveform at an off-screen cursor location can be displayed using the Jump function.
Refer to "7.3.3 Change Position (Jump Function)" (p. 133).

Read Measurement Values on Waveform Screen (for 1, 2, 4, 8 screens)

Press the **DISP** key to open the Waveform screen.

Screen display (time axis cursor)



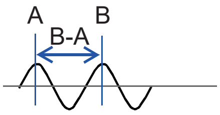
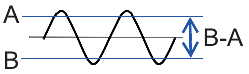
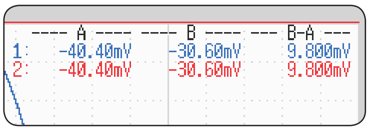
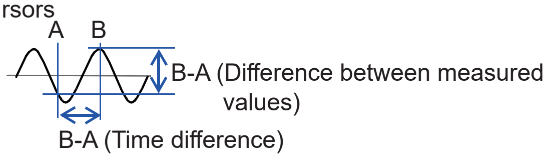
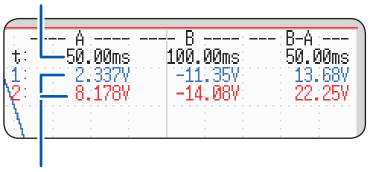
```
 ---- A ----  ---- B ---- --- B-A ---
t:  50.00ms   100.00ms    50.00ms
1/t  20.0 Hz   10.0 Hz    20.0 Hz
```

How cursor values are displayed depends on the selected cursor type.

Waveform values at the intersection with each cursor are displayed.

Time Value
To change the display type, refer to “Time Value” (“Time Value” (p. 314))

Cursor Value

Cursor types	Cursor value	Cursor value display example (with two cursors)
Div (Time Value and Frequency)	**t**: A, B cursor values: Time from trigger point or recording start B-A value: Time difference between AB cursors  **1/t**: Frequency for which t is 1 cycle	See “Screen display” above
Range (Measurement Values)	A, B each cursor value: Measured value of channel B-A value: Difference between measured values at AB cursors 	 ---- A ---- ---- B ---- --- B-A --- 1: -40.40mV -30.60mV 9.800mV 2: -40.40mV -30.60mV 9.800mV
Trace (Time and Measurement Values)	Time Values A, B cursor values: Time from trigger point or recording start B-A value: Time difference between AB cursors Measurement Value A, B cursor values: (Memory function) measurement value (Recorder function) maximum, minimum values B-A value: Difference between measured values at AB cursors  A B B-A (Difference between measured values) B-A (Time difference)	Time Values  ---- A ---- ---- B ---- --- B-A --- t: 50.00ms 100.00ms 50.00ms 1: 2.337V -11.35V 13.68V 2: 8.178V -14.08V 22.25V Measurement Values

You can press the **DISP** key to display the waveform and cursor values separately.
Refer to “7.7.3 Switch the Waveform Display Width” (p. 142).

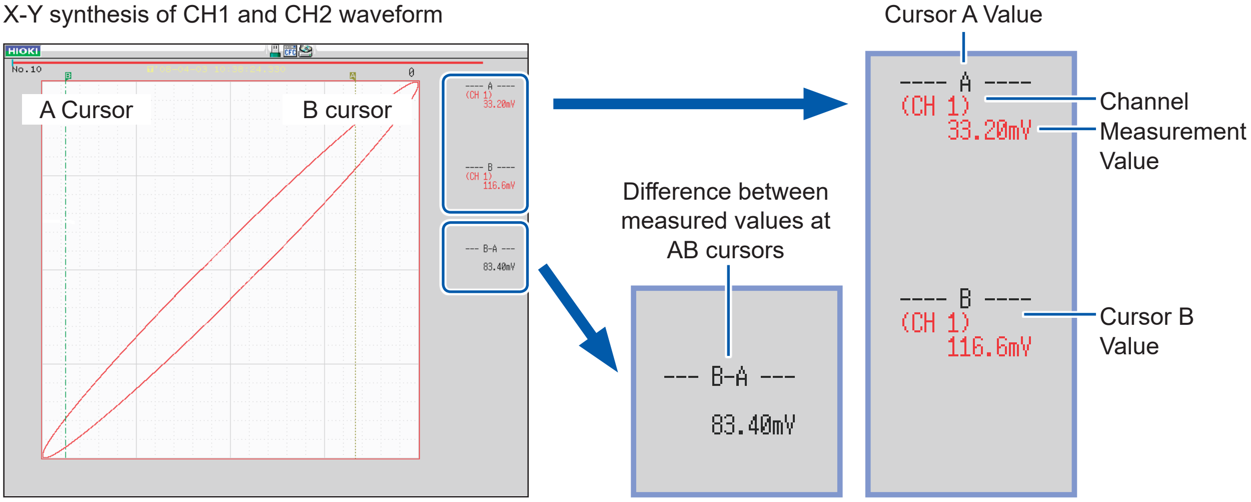
- When using external sampling: Value t is the number of samples.
- When the voltage range is changed during measurement by the recorder function or X-Y Recorder function, trace measurement values are acquired at the range settings when measurement was stopped. The data measured by MR8990 Digital Voltmeter Unit is updated after every 2 points the AB cursor moved.

Reading Measurement Values on Waveform Screen (for X-Y1, 4 screens)

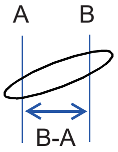
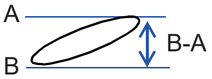
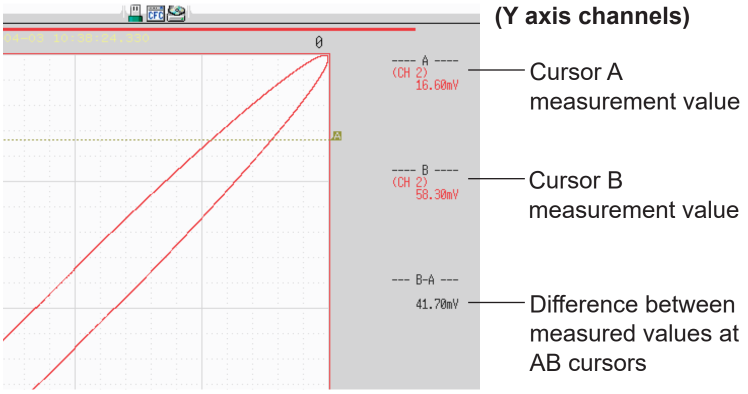
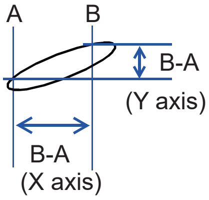
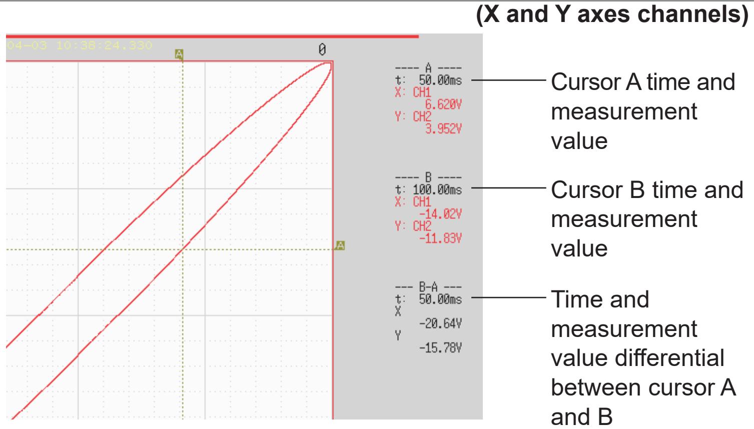
Press the **DISP** key to open the Waveform screen.

<Screen display (X axis measurement value)>

X-Y synthesis of CH1 and CH2 waveform

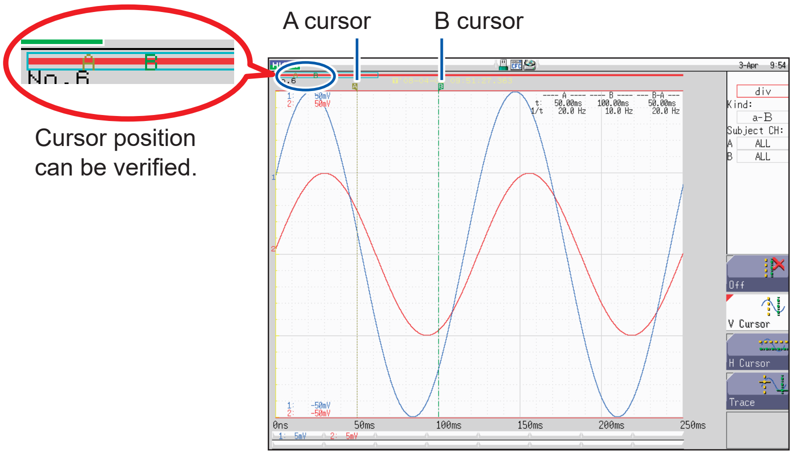


<Cursor Value>

Cursor types	Cursor Value	Cursor Value Display Example (with two cursors)
X axis (X axis measurement value)		See "Screen display" above
Y axis (Y axis measurement value)		 (Y axis channels) ---- A ---- (CH 2) 16.60mV Cursor A measurement value ---- B ---- (CH 2) 58.30mV Cursor B measurement value --- B-A --- 41.70mV Difference between measured values at AB cursors
Trace (Time and X axis, Y axis measurement value)		 (X and Y axes channels) ---- A ---- t: 50.00ms X: CH1 6.620V Y: CH2 3.952V Cursor A time and measurement value ---- B ---- t: 100.00ms X: CH1 -14.02V Y: CH2 -11.83V Cursor B time and measurement value --- B-A --- t: 50.00ms X -20.64V Y -15.78V Time and measurement value differential between cursor A and B

7.2 Specify a Waveform Range (AB Cursor)

When the waveform is shown as a time display, the range can be specified with the div cursor or trace cursor.
The specified range will be used for file saving, printing, X-Y synthesis, and numerical calculation. The range selection will be retained when the waveform display format is changed.



The general procedure is as follows.

1 **Set AB cursors**

Refer to “AB Cursor Settings” (p. 128).

2 **Specify a range**

- **For file saving**
  System screen - **[File Save]** sheet - **[Save Area]**, and then select **[A-B Wave]**.
  Refer to “5.2.2 Automatically Save Waveforms” (p. 88) or “5.2.3 Save Data Selectively (SAVE Key)” (p. 94).

- **For printing**
  System screen - **[Printer]** sheet - **[Slct Print Area]**, and then select **[A-B Wave]**.
  Refer to “6.2 Auto-print Settings” (p. 115) or “6.3 Manual Printing With the PRINT Key (Selective Printing)” (p. 118).

- **For X-Y synthesis**
  Status screen - **[Status]** sheet - **[Combo Area]**, and then select **[A-B Wave]**.
  Refer to “7.1 Read Measurement Values (Using the AB Cursors)” (p. 128).

- **For numerical calculation**
  Status screen - **[Num Calc]** sheet - **[Calc Area]**, and then select **[A-B Wave]**.
  Refer to “6.2 Auto-print Settings” (p. 115).

About reading measurement values and cursor types
Refer to “7.1 Read Measurement Values (Using the AB Cursors)” (p. 128).

Available range for AB cursor
The available range depends on the function.
- Memory function: Recorded measurement data for one measurement
- Recorder function: Up to the range of measurement data recorded during one measurement, or up to the range of measurement data that can be recorded internally, starting at the point at which measurement ended and going backwards in time.
  The maximum measurement data that can be recorded internally is 80,000 divs.

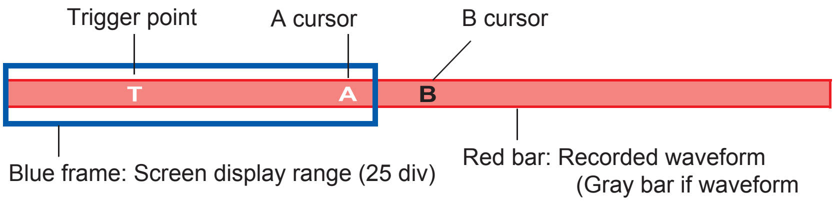
7.3 Move the Waveform Display Position MEM REC

This applies to the Memory and Recorder functions.

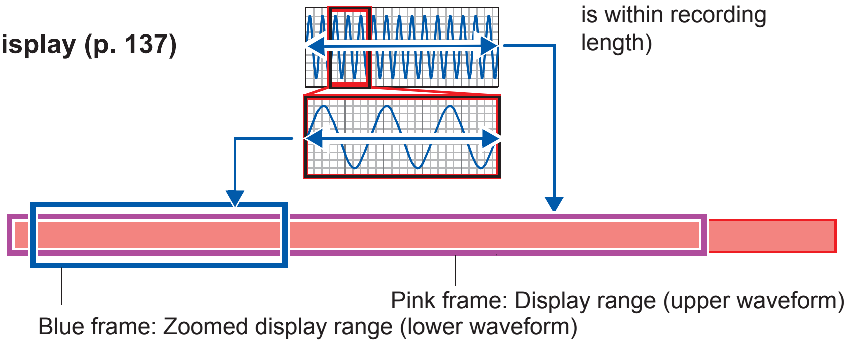
7.3.1 About the Display Position

From the scroll bar you can verify the relative position and size of the displayed portion of a waveform within the overall recorded waveform. Trigger time, trigger position and AB cursor positions (When using voltage axis cursor or trace cursors) are also displayed.

To verify the display range on the scroll bar

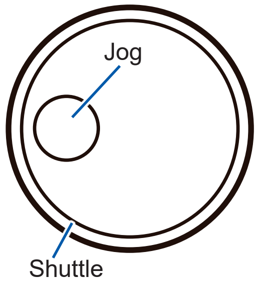

Trigger point
A cursor
B cursor
T
A
B
Blue frame: Screen display range (25 div)
Red bar: Recorded waveform
(Gray bar if waveform is within recording length)

With zoomed display (p. 137)


Pink frame: Display range (upper waveform)
Blue frame: Zoomed display range (lower waveform)

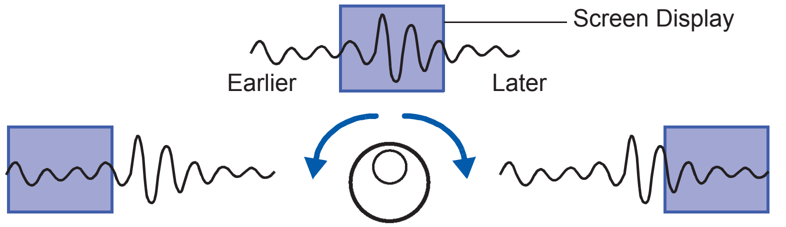
7.3.2 Scroll With Jog and Shuttle Knobs (Scroll)

When measuring or displaying an existing waveform, use the jog and shuttle knobs to scroll.



The scrolling speed is controlled by the rotation angle of the shuttle knob. Press the **WAVE** key to assign the jog and shuttle knobs to waveform scrolling. (While the **WAVE** key is lit, the jog and shuttle knobs can be used for scrolling.)

Scroll Direction



Turn CCW
Scrolls earlier on the waveform
from the current point.

Turn CW
Scrolls later on the waveform
from the current point.

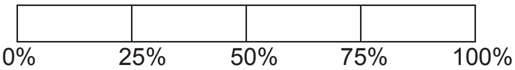
To see past waveforms in Roll Mode

The jog and shuttle knobs can be used to view past waveforms during measurement. To redisplay a waveform, select **[Scroll]**.

7.3.3 Change Position (Jump Function)

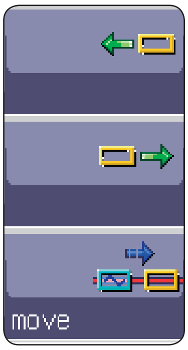
You can specify the portion to be displayed immediately.
Display location can be specified as follows:

- Trigger Point
- AB cursor location
- Specified location (from the beginning [0%] to the end [100%] of the waveform)



Procedure

Press the **DISP** key to open the Waveform screen, and then press the **WAVE** key to open the WAVE settings GUI displays.

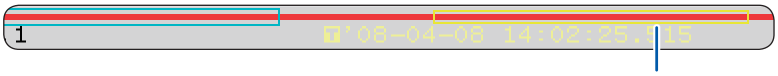


1 **Use the F keys [←], [→] to specify the position.**

The yellow frame on the scroll bar indicates the position to change to.

2 **Select [Move].**

The selected display position appears on the screen.



New position

To move the position when [Memory Div: On] with the Memory function
Press the **F1** key **[pos↔block]**. With no block displayed in the upper part of the screen, move the position.
When a block is displayed in the upper part of the screen, the desired block can be selected and the recorded waveform can be displayed. (p. 143)

7.4 Perform Waveform X-Y Synthesis

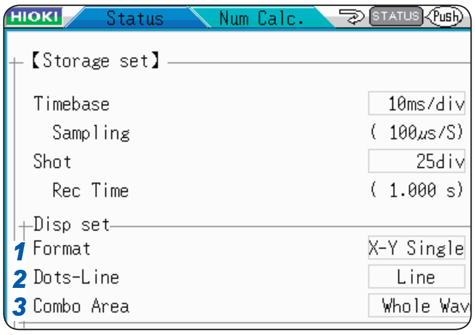
MEM **X-Y**

This applies to the Memory and X-Y Recorder functions.

- Using the recorder function causes Model 8990 to acquire data with a resolution of 16 bits.
- To perform waveform X-Y synthesis, go to the Status screen, select the **[Status]** sheet, and set **[Format]** to X-Y1 screen or X-Y4 screen. By assigning any analog channel to the X axis and Y axis, up to 8 X-Y combo displays can be generated.
- Vertical axis (voltage axis) zoom also applies to X-Y synthesis.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

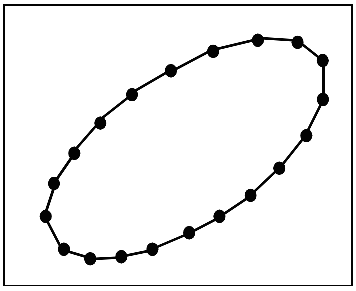


【Storage set】

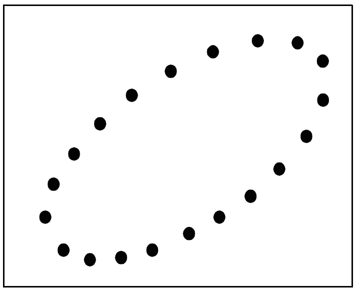
Timebase 10ms/div
Sampling (100μs/S)
Shot 25div
Rec Time (1.000 s)

Disp set

1 Format X-Y Single
2 Dots-Line Line
3 Combo Area Whole Wav



Line



Dots

1 **Move the cursor to [Format].**

X-Y Single	The waveforms of graphs 1 - 8 are shown and recorded on a single screen.
X-Y Quad	The waveforms of graphs 1 - 8 are shown and recorded on a four screens.

2 **Move the cursor to the [Dots-Line] item.**

Dots	Measurement data only are shown as dots. Order stored in memory will not be displayed.
Line	Measurement data are linked by a line in the order stored in memory and shown as a waveform. (*Default setting*)

3 **Move the cursor to [Combo Area].**

Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131).

Whole Wave	All data are used for X-Y synthesis.
A-B waveforms	Only data range marked by AB cursors is used for X-Y synthesis.

To speed up the time between measurement and waveform display

- The waveform will be displayed faster when **[Dots]** is selected for the Dot-Line interpolation setting.
- Specify a range using the AB cursors. (Memory Function only)

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the X-Y settings window.

4 **Set the waveform color in the graph display.**

Move the cursor to the channel for which you want to set the color, and choose the selection.

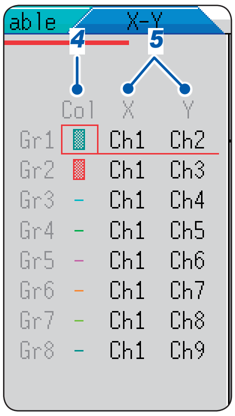
You can also select the same color as other channels.

Off	The waveform is not displayed. When [Save Channel] is set to **[Disp Ch]**, this channel will not be saved automatically. Refer to “Select the channels to save.” (p. 90)
On	The waveform is displayed. Select the display color with the **F** keys **[↑]**, **[↓]**.

5 **Select the channels for X-Y synthesis.**

Move the cursor to the items for the X (time axis) and Y (voltage axis) and assign a channel.

The same channel can be assigned multiple times.



	Col	X	Y
Gr1	▨	Ch1	Ch2
Gr2	▨	Ch1	Ch3
Gr3	-	Ch1	Ch4
Gr4	-	Ch1	Ch5
Gr5	-	Ch1	Ch6
Gr6	-	Ch1	Ch7
Gr7	-	Ch1	Ch8
Gr8	-	Ch1	Ch9

To synthesize waveforms between A and B cursors

Perform the following steps.

1. Press the **STATUS** key to bring up the Status screen, and select the **[Status]** sheet.
2. Select 1, 2, 4, 8 or 16 screens as **[Format]**.
3. Press the **DISP** key to display the Waveform screen.
4. Use the AB cursors to specify the range for synthesis. Refer to the following pages: (p. 128), (p. 131).
5. Press the **STATUS** key to bring up the Status screen, and select the **[Status]** sheet.
6. Select **[X-Y Single]** or **[X-Y Quad]** for **[Format]**.

To move pen on synthesized waveform

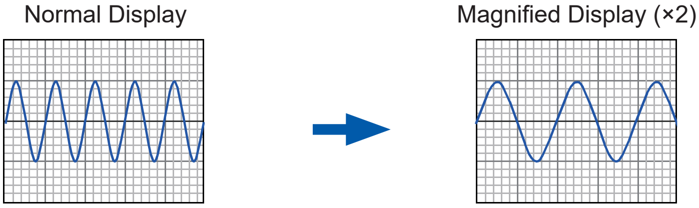
Press the **WAVE** key so that the key is lit. The pen can now be moved over the entire waveform with the jog and shuttle knobs. The time at the pen position is shown at the top right of the screen.

7.5 Magnify and Compress Waveforms

7.5.1 Magnify and Compress Horizontal Axis (Time Axis)

MEM **REC**

This applies to the Memory and Recorder functions. (However, with the Recorder function, waveform magnification is not available.)
Data details can be observed by magnifying the waveform along the horizontal axis (time axis). Also, by compressing the time axis, overall waveform fluctuations can be observed easily.
On-screen magnification and compression is based on the left edge of the screen. However, when the AB cursors appear on the screen, use the cursor as the standard to expand or compress. The amount of magnification/compression can be changed after measurement.



Normal Display

Magnified Display (×2)

Procedure

Press the **DISP** key to open the Waveform screen.

1 **Move the cursor to the Magnification.**

2 **Select display magnification.**

Memory Function

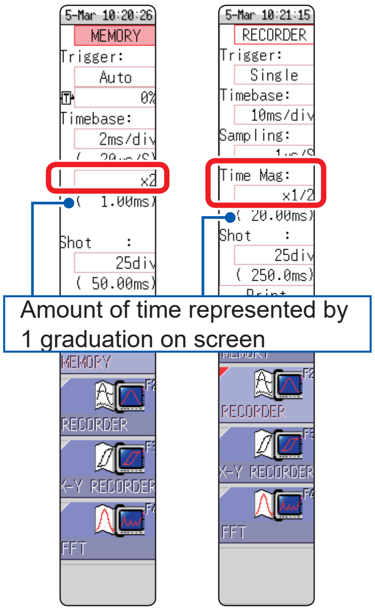
×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, 1/500, ×1/1000, ×1/2000, ×1/5000, ×1/10000, ×1/20000, 1/50000, ×1/100000, ×1/200000

When **[Zoom On]** is selected, a section of the time axis will be magnified.
Refer to “7.5.2 Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis))” (p. 137).

When **[All Wave]** is selected, the entire recording length waveform will be displayed.

Recorder Function

×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, ×1/500, ×1/1000, ×1/2000, ×1/5000, ×1/10000, ×1/20000, ×1/50000



5-Mar 10:20:26
MEMORY
Trigger:
Auto
0%
Timebase:
2ms/div
×2
(1.00ms)
Shot :
25div
(50.00ms)

5-Mar 10:21:15
RECORDER
Trigger:
Single
Timebase:
10ms/div
Sampling:
Time Mag:
×1/2
(20.00ms)
Shot :
25div
(250.0ms)

Amount of time represented by 1 graduation on screen

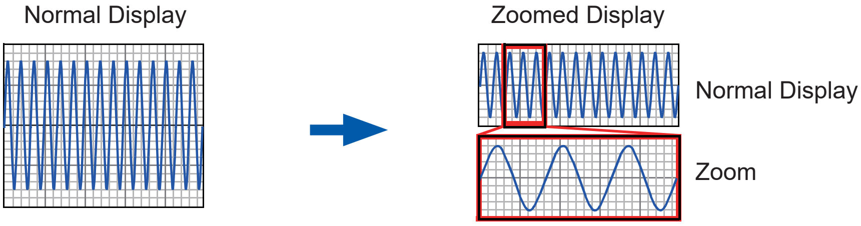
To print at a different zoom ratio from the display

Specify the ratio on the **[Printer]** sheet.
Refer to “Set the horizontal axis (time axis) magnification and compression.” (p. 122).
When a waveform loaded from media is displayed at a high compression ratio, the display may be slow to update.

7.5.2 Zoom Function (Magnifying a Section of the Horizontal Axis [Time Axis])

MEM

This applies to the Memory function only. A magnified section of a waveform can be displayed together with the unmagnified view by splitting the screen horizontally.
With the waveform displayed normally on the upper half of the screen, a section magnified along the time axis can be displayed on the lower half.



When you press the **PRINT** key while using the Zoom function, the waveform displayed on the lower half of the screen is printed. (The print format will be as for a single screen waveform. If the AB cursors are used, the selected section will be printed.)

Procedure

Press the **DISP** key to open the Waveform screen.

1 **Move the cursor to the magnification.**

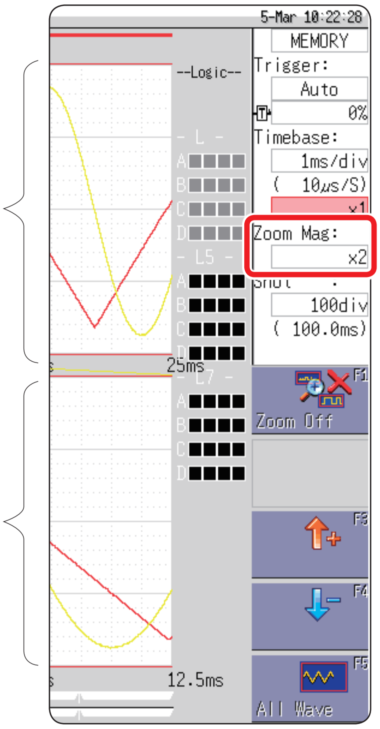
2 **Select [Zoom On].**

The Zoom function is enabled and the screen is split into upper and lower halves.
(Upper: waveform to be magnified; Lower: magnified (zoomed) section of waveform)

3 **Select display magnification for the zoomed waveform section.**

Move the cursor to the [Zoom Mag], and set the magnification.

The zoomed waveform section at the lower half of the screen is magnified.
When the same value or a smaller value than the magnification/compression ratio is specified, the ratio is automatically set to a setting one step higher than the [Zoom Mag] setting.



MEMORY
Trigger: Auto
0%
Timebase: 1ms/div
(10μs/S)
x1
Zoom Mag: x2
Shot : 100div
(100.0ms)

Magnifying and Compressing ratio waveform

Zoom ratio waveform

4 **Scrolls the zoomed section of the waveform.**

Refer to "7.3.2 Scroll With Jog and Shuttle Knobs (Scroll)" (p. 132).

To cancel Zoom

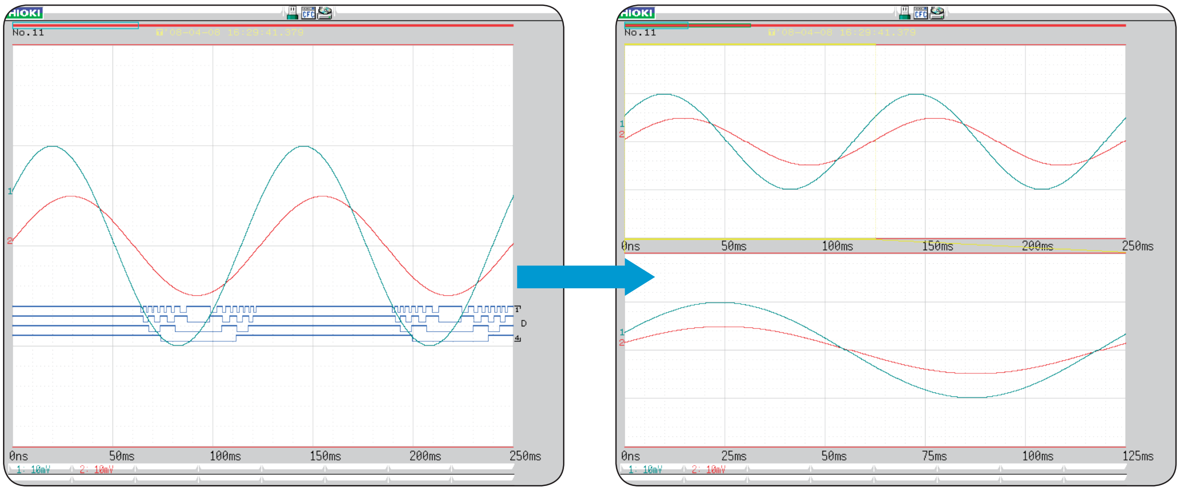
Move the cursor to the magnification, and select [Zoom Off]. (The condition is canceled while keeping the inherited zoom ratio.)
Example: When the zoom ratio was set to ×5 and zoom is canceled, the ratio setting will be [×5].

To view the entire waveform (Memory function only)

Move the cursor to the ratio item in the settings window and select **[All Wave]**. The waveform information for the entire recording length will be displayed.

About logic waveform display

When the Zoom function is enabled and the logic waveform display position is at less than **[50pos]**, the logic waveform will not be displayed.
Example: Display position **[30pos]**

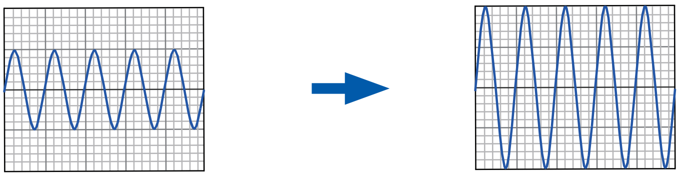

Normal Display

Zoomed Display

7.5.3 Vertical Axis (Voltage Axis) Magnification

MEM **REC**

This applies to the Memory and Recorder functions.
Waveforms on each channel can be magnified or compressed along the vertical axis (voltage axis) for display or printing.
Magnification and compression are based on the zero position.


Normal Display

Magnified Display (×2)

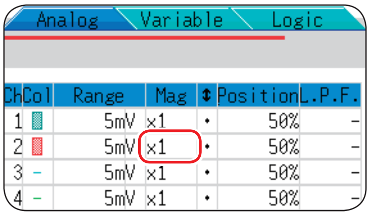
Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the channel settings window (**[Analog]** sheet).

Move the cursor to the [Mag] item of the channel to adjust.

×1/10, ×1/5, ×1/2, ×1, ×2, ×5, ×10, ×20, ×50, ×100

Selecting **[Invert]** will invert plus and minus in the waveform.
Refer to “8.8 Invert the Waveform (Invert Function)” (p. 168).



Ch	Col	Range	Mag	⇕	Position	L.P.F.
1	🟦	5mV	×1	•	50%	-
2	🟥	5mV	×1	•	50%	-
3	-	5mV	×1	•	50%	-
4	-	5mV	×1	•	50%	-

To display at an arbitrary ratio

Refer to “8.6 Set the Waveform Position (Variable Function)” (p. 164).

7.6 Monitor Input Levels (Level Monitor)

7.6.1 Level Monitor

All input waveform levels can be monitored in real time.
Analog channels and logic channels can be displayed at the same time.

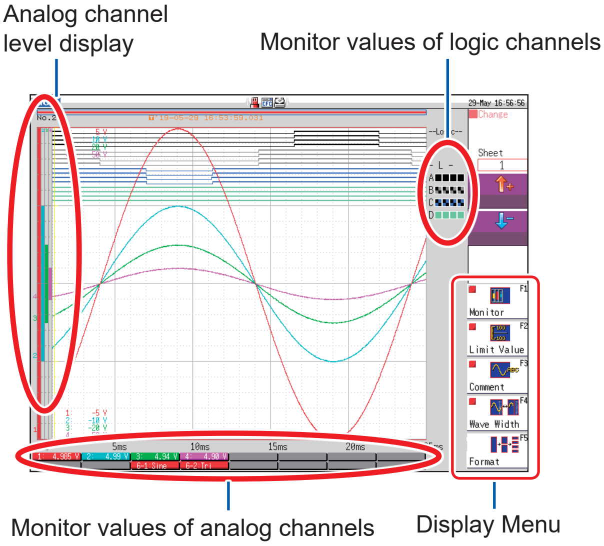
Procedure

Press **DISP** to open the Menu → Display Menu

Selecting **[Monitor]** brings up the analog channel level display in the left part of the Waveform screen, and the logic channel level display in the right side of the Waveform screen.

To hide the level monitor

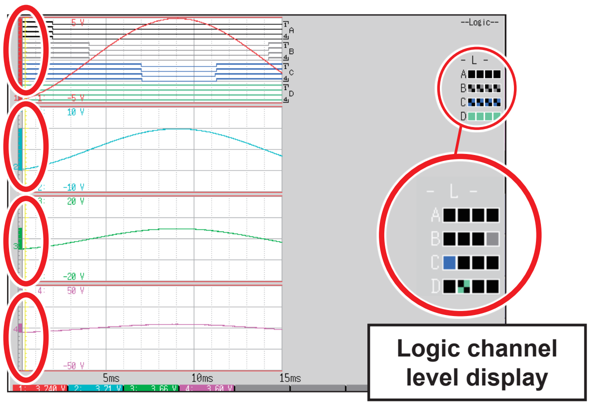
Select **[Monitor]** again.


Analog channel level display
Monitor values of logic channels
Monitor
Limit Value
Comment
Wave Width
Format
Monitor values of analog channels
Display Menu

Display format 2 - 16 screens (p. 65)
Level monitors are displayed for each graph.

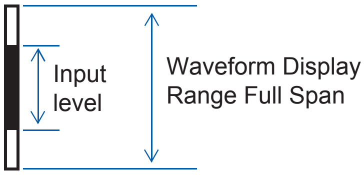
Upper and lower limit indication is combined with level monitor.

Refer to "7.7.1 Show Upper/Lower Limit on Waveform Screen" (p. 142).

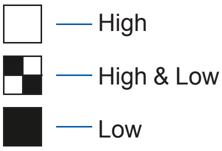


How to Interpret Level Monitors

Analog channel level display



Logic channel level display



When the display setting is On, the part indicated in white takes the color specified for the waveform display. When the setting is Off, the part becomes gray. The part indicated in black is the background color.

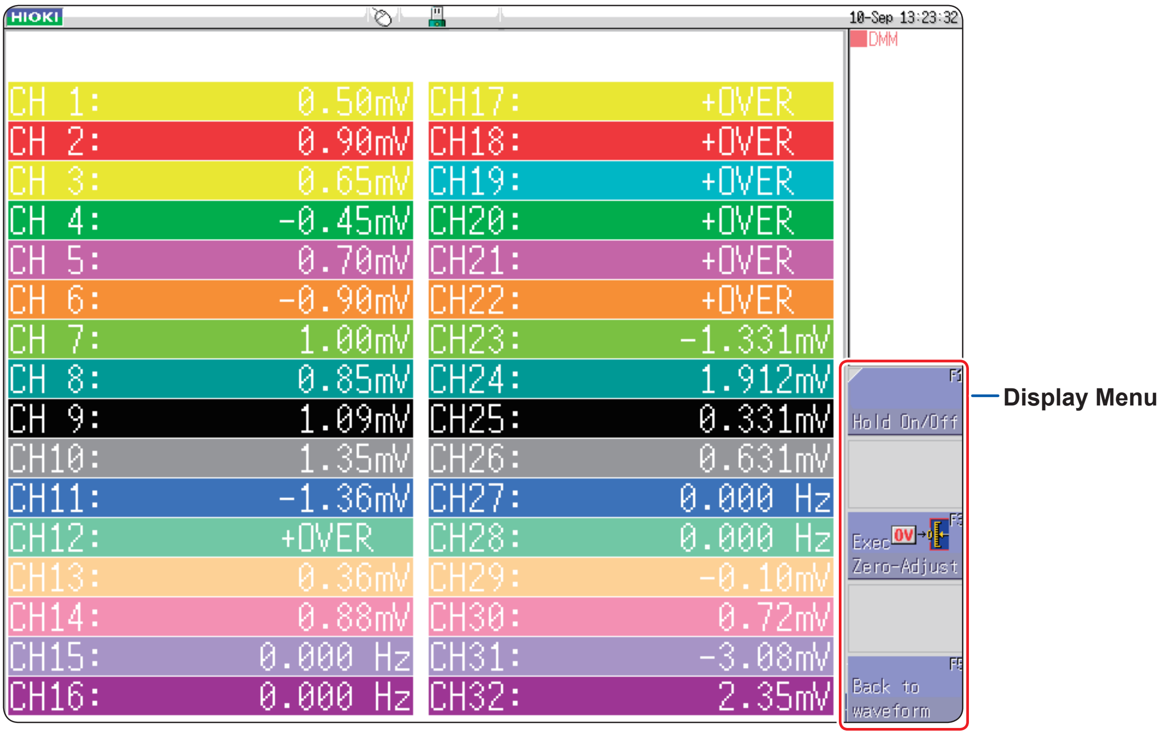
- Input levels are not displayed for channels that have no corresponding module installed.
- Channels higher than the number specified for **[Used Ch]** do not display analog input levels. (Example: When **[Used Ch]** is set to **[Ch4]**, the levels for CH3 to Ch16 and Ch19 to Ch32 are not displayed.)

7.6.2 Numerical Value Monitor

Input values can be monitored as numerical value same as in DMM (Digital multimeter).

Procedure

To open the screen: press the **DISP** key twice.



CH 1:	0.50mV	CH17:	+OVER
CH 2:	0.90mV	CH18:	+OVER
CH 3:	0.65mV	CH19:	+OVER
CH 4:	-0.45mV	CH20:	+OVER
CH 5:	0.70mV	CH21:	+OVER
CH 6:	-0.90mV	CH22:	+OVER
CH 7:	1.00mV	CH23:	-1.331mV
CH 8:	0.85mV	CH24:	1.912mV
CH 9:	1.09mV	CH25:	0.331mV
CH10:	1.35mV	CH26:	0.631mV
CH11:	-1.36mV	CH27:	0.000 Hz
CH12:	+OVER	CH28:	0.000 Hz
CH13:	0.36mV	CH29:	-0.10mV
CH14:	0.88mV	CH30:	0.72mV
CH15:	0.000 Hz	CH31:	-3.08mV
CH16:	0.000 Hz	CH32:	2.35mV

When mouse is connected, you can display numerical value (DMM) by clicking on **[DMM]** icon appears at the upper right of Waveform screen.

DMM

When returning to Waveform screen

Press the **[Return to Waveform screen]** appears at the right side of the Display menu screen or press **DISP** key.

To pause (hold) the display

Press **[HOLD On/Off]** appears at the right side of the Display menu screen.
HOLD mark which indicates the HOLD status will be displayed on screen.

To cancel the pause (hold) of display

Press **[HOLD On/Off]** to cancel the HOLD status.

When executing Zero-adjust

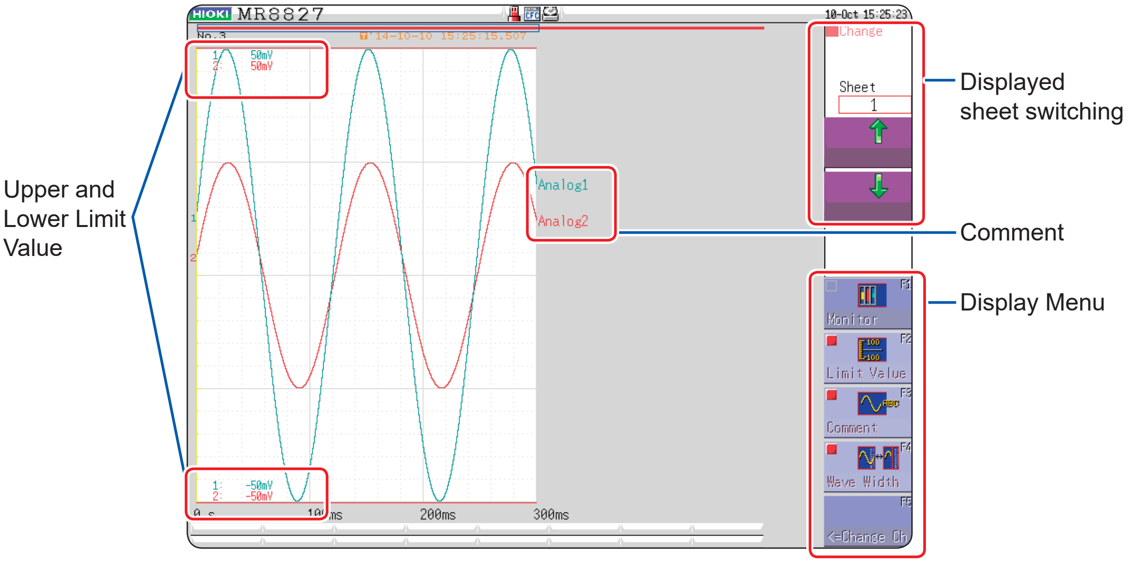
Zero-adjust (calibration in Model MR8990) can also be run on Numerical value (DMM) display screen. Press the **[Exec. Zero-Adjust]** appears at the right side of the Display menu screen.

7.7 Switch the Waveform Screen Display (Display Menu)

The display menu allows you to bring up additional information such as upper/lower limit value indication and comment display. It also allows you to set the waveform display width.
Refer to “About level monitor” (p. 139).

Procedure

Press **DISP** to open the menu → File screen, Press **DISP** → Select the [WAVE WIDTH] menu



To hide the menu

Select the same menu again.

7.7.1 Show Upper/Lower Limit on Waveform Screen

Select **[Limit Value]** to show the upper/lower limit value indication on the Waveform screen.

7.7.2 Show Comments on Waveform Screen

Select **[Comment]** to show the comment indication on the Waveform screen.

- Comment information must have been entered via the **[Comment]** sheet on the Channel screen.
  Refer to “8.1 Add Comments” (p. 146).
- When they overlap with other displayed elements, the comments may not display properly. Hide the Channel Settings Window, Trigger Settings Window, Level Monitor, etc., or decrease the **[Wave Width]**.

7.7.3 Switch the Waveform Display Width

Select **[Wave Width]** to change the display width of the Waveform screen.
If a waveform is hard to see because of numeric value and settings information, this function can be used to separate the waveform and other information.
The function is also active for the Channel settings window and Trigger settings window.

7.7.4 Switch the Channel Range Information Display

Each time you press the **[<= Change Ch]**, the channel range information displayed at the lower part of the screen changes between CH1 to CH16 and CH17 to CH32.

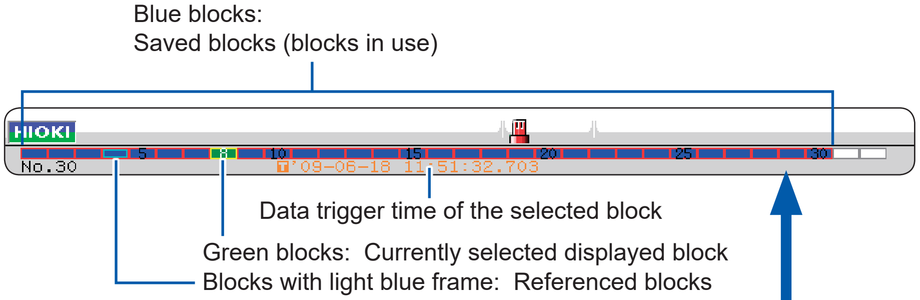
7.7.5 Switch the Displayed Sheet

Select **[↑]**/**[↓]** to switch the displayed sheet.
The settings of each displayed sheet can be specified on the Unit List tab of the Channel settings window.
Refer to “3.4.4 Displayed Sheet” (p. 73).

7.8 View Block Waveforms

MEM

This applies to the Memory function only.
You can check if blocks have been used when recording with memory division. Furthermore, the desired block can be selected and the recorded waveform displayed.
When memory division is not used, depending on the recording length, it is possible to display the last 16 measured waveforms.
Refer to “7.1 Read Measurement Values (Using the AB Cursors)” (p. 128).



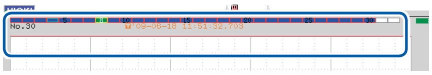
Blue blocks:
Saved blocks (blocks in use)

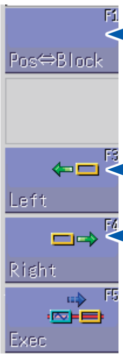
Data trigger time of the selected block

Green blocks: Currently selected displayed block
Blocks with light blue frame: Referenced blocks

1 Press the **DISP** key to display the waveform.

2 Press the **WAVE** key.





3 Select **[Pos↔Block]**.
The block is displayed in the upper part of the screen.

4 Use **[Left]** or **[Right]** to move the displayed block.

To overlap with other blocks (reference blocks)

Open the Status screen to the **[Memory Div]** sheet and set **[Ref Block]** to **[On]** and select **[All Blks On]**.
Refer to “12.2 Display Settings” (p. 248).

8 Utility Functions

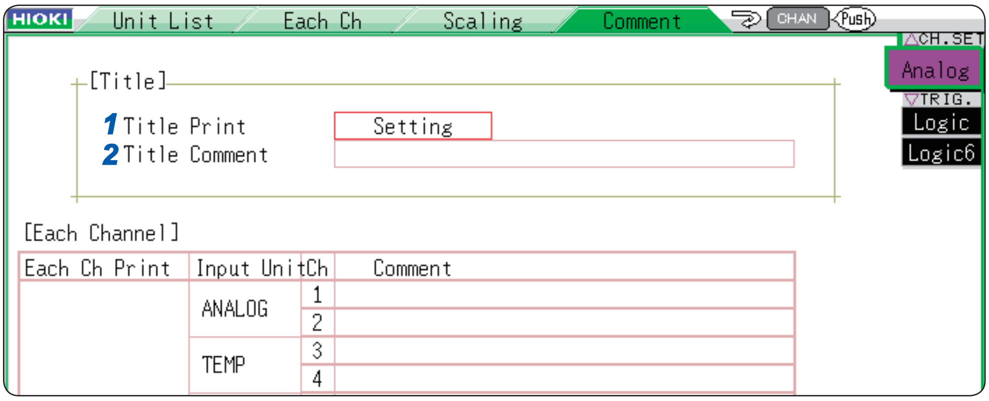
8.1 Add Comments

8.1.1 Add a Title Comment

When you enter a title comment, it can be displayed at the top of the Waveform screen, and can also be printed.
(Allowed number of characters: up to 40)
Refer to “6.6.2 Report Print (A4 Size Print)” (p. 124).

Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Comment]** sheet.



[Title]

1 Title Print: Setting

2 Title Comment:

[Each Channel]

Each Ch Print	Input Unit	Ch	Comment
	ANALOG	1	
		2	
	TEMP	3	
		4	

1 **Set the print title content**

Move the cursor to **[Title Print]** for the title.

Off	Title comment not printed.
Setting	Equipment settings will be printed.
Comment	Title will be printed.
Set& Com	Both equipment settings and title will be printed.

2 **Enter a title comment.**

Move the cursor to **[Comment].**

Input	Enter comment text. Refer to “Entering Text” (p. 149).
Clear	Clear entered information
Undo	Return to the state before the most recent change

To select from preset terms

Pressing the **WAVE** key after activating text input brings up a list of preset terms.
It is also possible to select words from previously entered titles (History function).
Refer to “Enter Text From a Term List or History List” (p. 151).

8.1.2 Add a Channel Comment

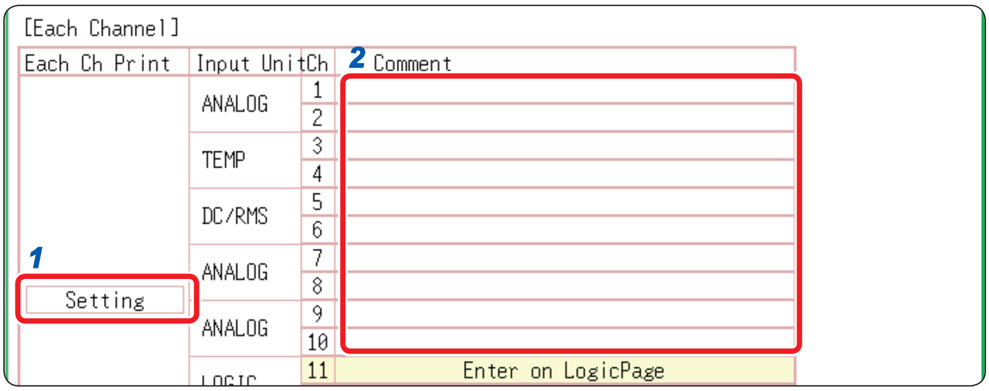
Comments added for each channel can be displayed on-screen. Comments can also be printed on recording paper. (Allowed number of characters: up to 40)

To copy a comment to another channel

The **[Comment]** sheet can be used to copy comments.
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169)

Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Comment]** sheet.



1 **Select the print content for each analog channel.**

Move the cursor to **[Each Ch Print]** for each channel.

Off	No channel comment will be printed.
Setting	Settings for each channel will be printed. (Not displayed on screen)
Comment	Comments for each channel will be printed.
Set& Com	Both settings and comments for each channel will be printed.

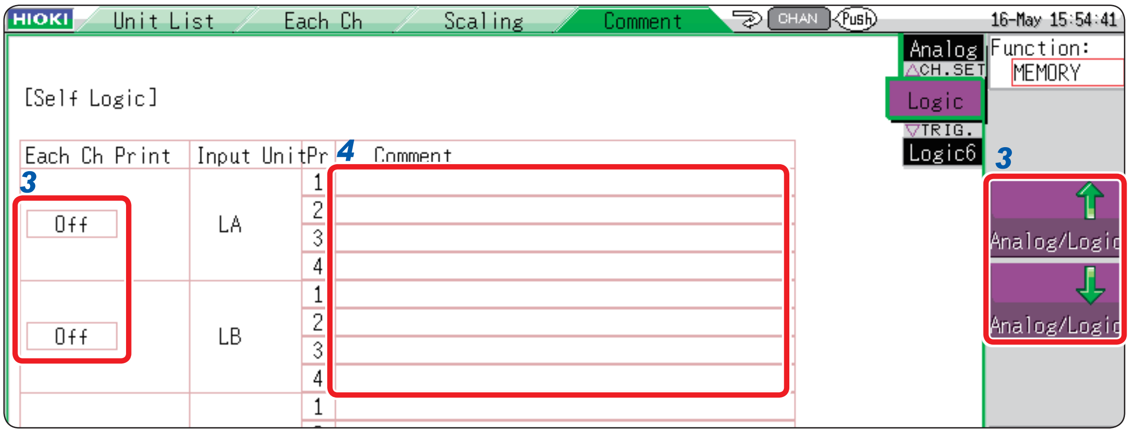
2 **Enter comments for each analog channel.**

Move the cursor to **[Comment].**

Input	Enter comment text. Refer to “Entering Text” (p. 149).
Clear	Clear entered information
Undo	Return to the state before the most recent change

To select from preset terms

Pressing the **WAVE** key after activating text input brings up a list of preset terms.
It is also possible to select words from previously entered analog channels (History List).
Refer to “Enter Text From a Term List or History List” (p. 151).



3 **Select the print content for each logic channel.**

Select **[Analog/Logic]** to display the logic channel page.

Move the cursor to **[Each Ch Print].**

Off	Comments are not printed.
Comment	Comments are printed.

4 **Enter the comment for each logic channel.**

Move the cursor to **[Comment].**

Input	Enter comment text. Refer to “Entering Text” (p. 149).
Clear	Clear entered information
Undo	Return to the state before the most recent change

To select from preset terms

Pressing the **WAVE** key after activating text input brings up a list of preset terms.
It is also possible to select words from previously entered logic channels (History List).
Refer to “Enter Text From a Term List or History List” (p. 151).

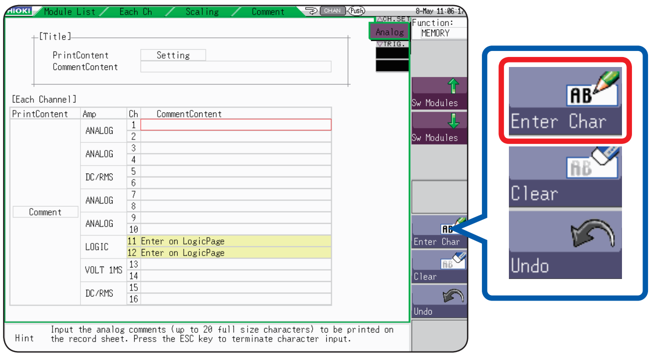
8.1.3 Alphanumeric Input

Move the cursor to the setting item for which you with to input text and choose the content with the **F** keys.

Entering Text

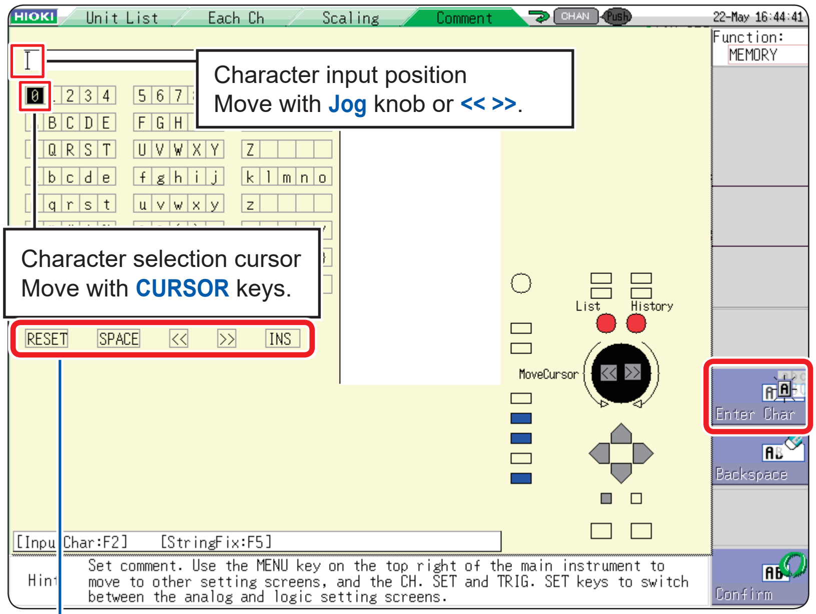
1 **Move the cursor to the comment field and select [Enter Char].**

The virtual keyboard will be displayed.



Hint Input the analog comments (up to 20 full size characters) to be printed on the record sheet. Press the ESC key to terminate character input.

2 **Select characters with the CURSOR keys from the virtual keyboard, and select [Enter Char] to enter it.**



Character input position
Move with **Jog** knob or **<< >>**.

Character selection cursor
Move with **CURSOR** keys.

Hint Set comment. Use the MENU key on the top right of the main instrument to move to other setting screens, and the CH. SET and TRIG. SET keys to switch between the analog and logic setting screens.

RESET	Deletes all entered characters (Move the cursor to **RESET**, and push **[Enter Char]**.)
SPACE	Inserts a space (Move the cursor to SPACE, and push **[Enter Char]**.)
OVWR/INS	Toggles between Overwrite (OVWR) and Insert (INS) mode (Move the cursor to **[OVWR/INS]**, and push **[Enter Char]** to switch OVWR/INS.)
<<	Move the character input position left.
>>	Move the character input position right.

3 **Select [Confirm] to accept the entry.**

The virtual keyboard will disappear.
Press the **ESC** key to cancel the input.
(Pressing the **ESC** key again closes the virtual keyboard)

To Enter units and symbols

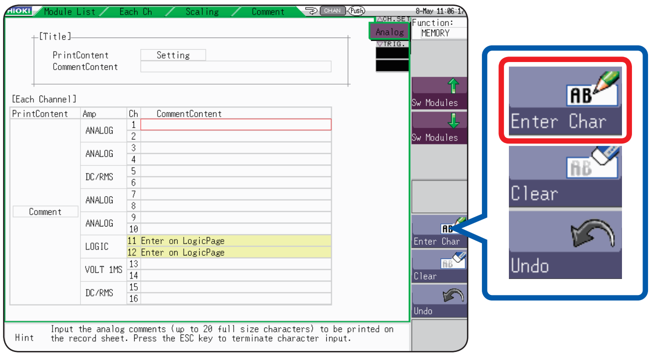
Characters entered as units may be saved differently.
(Saving of numerical calculation results or text format information)
^{2} → ^2, ^{3} → ^3 , µ → ~u, Ω → ~o, ε → ~e, ° → ~c , ± → ~+
Characters not allowed in file names can not be entered. (Please use only uppercase letters.)

Enter Text From a Term List or History List

While the virtual keyboard is displayed, pressing the **WAVE** key brings up a “Term List” and pressing the **AB CSR** key brings up a “History List.”
This can be used to enter preset terms or reuse text from previous input sessions.

1 **Move the cursor to the comment field and select [Enter Char].**

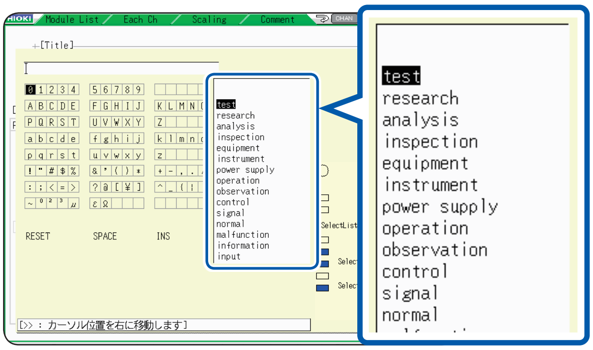
The virtual keyboard will be displayed.



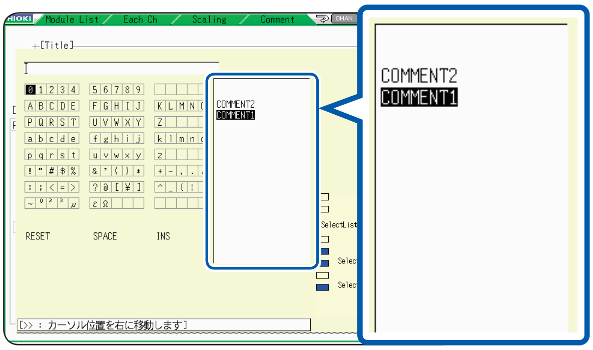
Hint Input the analog comments (up to 20 full size characters) to be printed on the record sheet. Press the ESC key to terminate character input.

2 **Press the WAVE key to select from preset terms.**

A list of preset terms will be displayed.



Press the **AB CSR** key to select from the past inputs.
A History list will be displayed.



Press the ESC key to cancel selection from the history list.

3 **Use the Up/down CURSOR keys or the jog knob to select a term from the list, and select [Enter Char].**

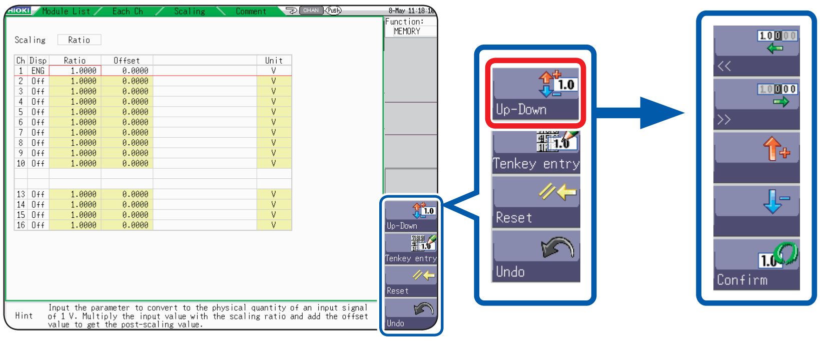
4 **Select [Confirm].**

The entry is accepted.
The virtual keyboard will disappear.

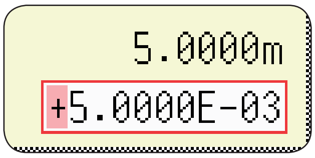
Entering Numerals By Incrementing/Decrementing

1 **Move the cursor to the numeric input field and select [Up-Down].**

A virtual keyboard for digit input will be displayed.



2 **Enter numerals at the virtual keyboard.**
(Use F1 and F2 to move digit position, and use F3 and F4 to increase or decrease the value.)


5.0000m

+5.0000E-03

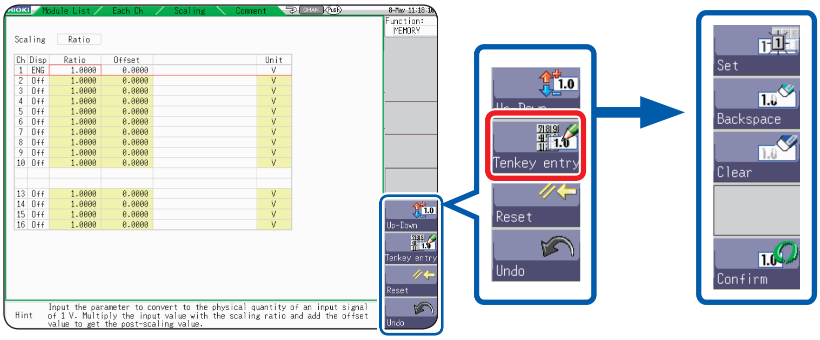
3 **Select [Confirm] to accept the entry.**

Press the **ESC** key to cancel the input.

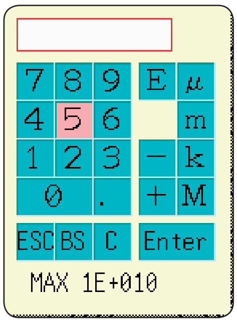
Enter Numerals With a Numeric Keypad

1 **Move the cursor to the numeric input field and select [Tenkey Entry].**

A virtual keyboard for numeric keypad input will be displayed.



2 **Enter numeral at the virtual numeric keypad.**



ESC:	Cancel input
BS:	Delete 1 character
C:	Delete all characters
Enter:	Accept the entry

3 **Select [Confirm] to accept the entry.**

Press the **ESC** key to cancel the input.

8.2 Display Waveforms During Recording (Roll Mode) MEM

This applies to the Memory function only.
You can display and print the waveform at the same time as the data is acquired (if auto-print is enabled). (p. 115)

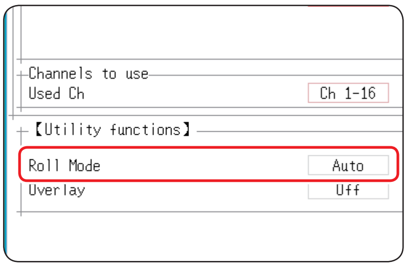
- If measurement is carried out at low sampling rate using the Memory function, a long time will be required until data for the entire recording length have been collected. Roll Mode is useful in these cases.
- The new waveform scrolls automatically.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

Move the cursor to [Roll Mode].

OFF	Normal recording. Data is displayed only after acquiring the specified recording length.
On	Waveforms are displayed while recording (with 10 ms and slower settings). When the timebase is set to 5 ms/div or faster, waveforms are not displayed until after acquisition has finished.
AUTO	Regardless of the timebase setting, whether or not the waveform is displayed depends on the waveform display magnification settings while the data is being recorded. (Default setting) However, when the waveform is displayed using a time axis faster than 100 ms per division, or when the time base is 5 μs/div, the waveform will be displayed after it has been captured.



Channels to use
Used Ch Ch 1-16
【Utility functions】
Roll Mode Auto
Overlay Off

When the Roll mode function is [On]

- ***Roll Mode function and Overlay function cannot be used together.***
  When the Roll Mode function is enabled, the Overlay function is automatically set to **[Off]**. And when the Overlay function is enabled, Roll mode is set to **[Auto]**. (p. 154)
- The roll mode, memory division and waveform calculation functions cannot be used simultaneously.

Roll Mode Function	Memory Division Function	Waveform Calculation Function
On	**Off**	**Off**
Off	**On**	**Off**
Off	**Off**	**On**

Note: When one function is set to **[On]**, the other functions are automatically set to **[Off]**.

- When auto-print (p. 115) is enabled, printing is available simultaneously with waveform display (if the internal printer is installed). However, for X-Y waveforms, all data must be acquired before printing.
  In addition, during evaluation by numerical calculation, automatic printing is carried out according to the evaluation conditions when numerical calculation finishes.

When the Roll Mode function is [Off]

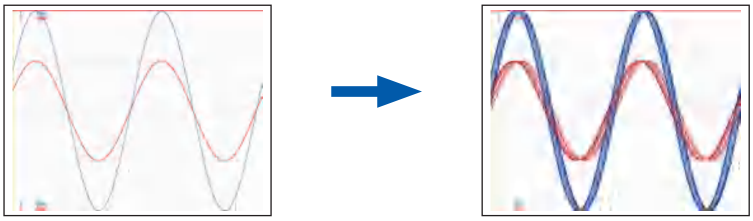
Waveforms are displayed after the data has been acquired for the entire recording length, so with slow sampling there may be a long wait after starting measurement before the waveform is displayed.

8.3 Display New Waveforms Over Past Waveforms (Overlay)

MEM

This applies to the Memory function only.
Displayed waveforms are retained on-screen and overlaid with new waveforms.

- Use this to compare new waveforms with those recorded immediately before. (When the trigger mode is **[Repeat]** or **[Auto]**) (p. 197)
- There are two overlay methods: automatic overlay during measurement and manual overlay.



Normal display

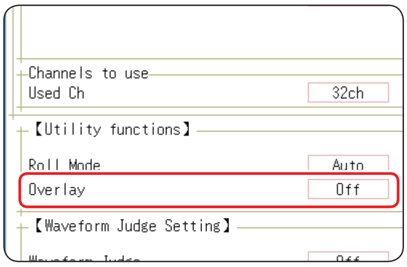
Waveforms with the Overlay Function

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

Move the cursor to [Overlay].

Off	Overlay disabled. *(Default setting)*
Auto	Each time a waveform is acquired, it is automatically displayed as an overlay. When the trigger mode is **[Cont.]** or **[Auto]**, waveforms will be overlaid from measurement start to stop.
Manual	Overlay waveforms on the screen manually. (See the next section for the method of overlay.)



Channels to use
Used Ch 32ch
【Utility functions】
Roll Mode Auto
Overlay Off
【Waveform Judge Setting】

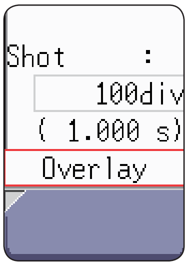
This mode cannot be used simultaneously with Roll Mode.
Refer to "When the overlay function is enabled ([Auto] or [Manual])." (p. 155).

Manual Overlay (Any Waveform Can Be Retained On-Screen)

Press the **DISP** key to open the Waveform screen.

Move the cursor to [Overlay].

Overlay (**F1** key)	The loaded waveform on the screen. The overlay is displayed until the waveform is cleared.
Clear (**F5** key)	Clears the screen of all overlaid waveforms. Cleared waveforms cannot be displayed again.



Shot :
100div
(1.000 s)
Overlay

When the overlay function is enabled ([Auto] or [Manual]).

- The Roll Mode function (p. 153) and Overlay function (p. 154) cannot be enabled at the same time.
  When the Roll Mode function is enabled, the overlay is automatically set to **[Off]**.
  And when the overlay function is enabled, roll mode is set to **[Auto]**.
- Printing and AB Cursor tracing apply only to the last-acquired waveform.
- The following operations are not available on the waveform screen:
  Waveform scroll, Zoom function On/Off, Change horizontal axis (time axis) magnification/compression, Change zero position.
- In the following cases, overlaid waveforms are cleared and only the most recent waveform is displayed.
    - When **[Format]** is changed on the **[Status]** sheet
    - When **[Combo Area]** has been changed **([Format]** set to **[X-Y Single]** or **[X-Y Quad])**
    - Waveform display setting is changed on the **[Unit List]** or **[Each Ch]** sheets (Display magnification, zero position, variable, display on/off, waveform color)

8.4 Setting Channels to Use (Extending the Recording Length)

MEM

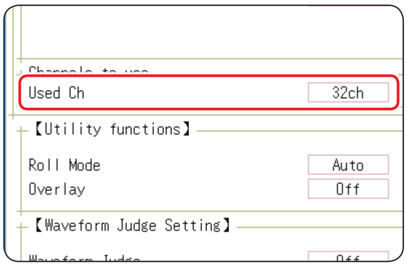
This applies to the Memory function only.
Select the analog and logic channels to use.
Maximum recording length is available when the fewest necessary channels are enabled for use.
Minimizing the number of channels in use allows memory to be reallocated to those channels being used.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

Move the cursor to the [Used Ch], and select the number of channels to use.

4ch/ 8ch/ 16ch/ 32ch *(Default setting)*


Used Ch 32ch
【Utility functions】
Roll Mode Auto
Overlay Off
【Waveform Judge Setting】

Standard logic channels LA to LD are stored by using 4 bits of analog channels CH1 to CH4, and standard logic channels LE to LH are stored by using 4 bits of analog channels CH9 to CH12.

Available channels

When **[Used Ch]** is set, the available analog channels, standard logic channels, and the logic channels of Model 8973 Logic Unit are as follows.

Used channel	Analog	Standard logic	Model 8973 Logic Unit
4ch	CH1, CH2, CH17, CH18	LA, LB, LE, LF	L1
8ch	CH1 to CH4, CH17 to CH20	LA to LH	L1, L2
16ch	CH1 to CH8, CH17 to CH24	LA to LH	L1 to L4
32ch	CH1 to CH32	LA to LH	L1 to L8

Note that the maximum number of logic units that can be installed on the instrument is two.

Precautions for Installation of Model MR8791 Pulse Generator Unit

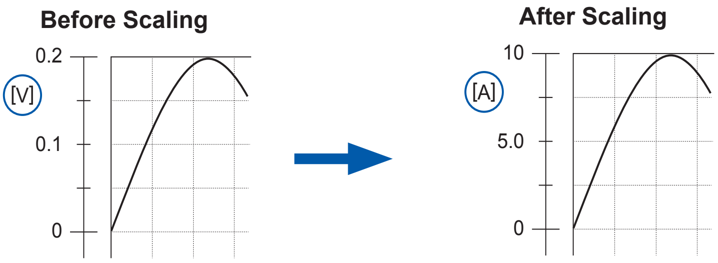
- When the used channels is changed, the pattern data will be erased.
- The pattern output can be selected only when used channel is set to 32 ch.

8.5 Convert Input Values (Scaling Function)

About the Scaling Function

Use the scaling function to convert the measured voltage units output from a sensor to the physical units of the parameter being measured.
Hereafter, **“scaling”** refers to the process of numerical value conversion using the Scaling function.

Gauge scales, scale values (upper and lower limits of the vertical axis [voltage axis) and AB cursor measurement values can be displayed in scaled units.
Scaling is available for each channel.



Scaling Examples

Refer to “When using a clamp sensor” (p. 159) (Example: Converting [V] to [A]) or “When using the Strain Unit ” (p. 160) (Example: Converting [με] to→ [G]).

Scaling Methods

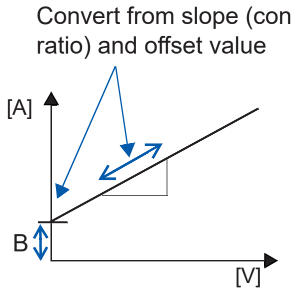
Two scaling methods are available:

- Conversion Ratio Setting
- Two-Point Setting

Set with a Conversion Ratio

(Example: Converting [V] to [A])

Set the physical value per volt (conversion ratio: eu/V) of the input signal, an offset value and measurement unit name (eu: engineering units) for conversion, so measurement values acquired as voltage are converted to the specified units.
(Example)
Conversion ratio: A value per volt, Offset value: B
Unit name: A

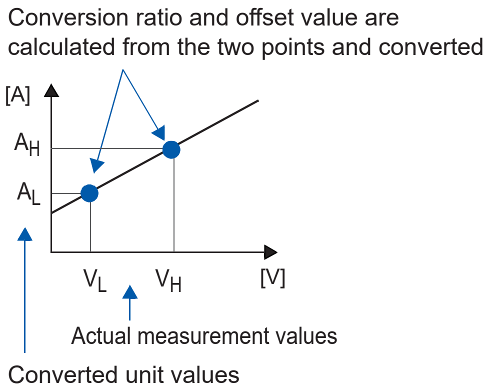


Set with Two Points

Set the voltage values of two points of the input signal, the converted unit value of these two points and the name of the converted measurement units, so measurement values acquired as voltage are converted to the specified units.
(Example)

Voltage value at 2 points		Voltage of units to convert	
V_H:	Higher potential point	A_H:	Value for higher potential point
V_L:	Lower potential point	A_L:	Value for lower potential point

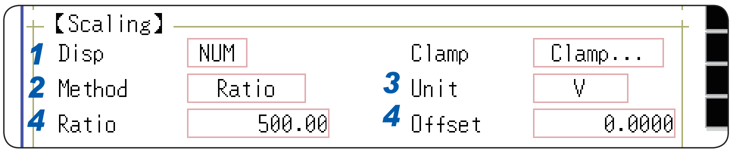
Unit name: A


Conversion ratio and offset value are calculated from the two points and converted
[A]
A_H
A_L
V_L
V_H
[V]
Actual measurement values
Converted unit values

When the conversion ratio setting is changed, V_L and V_H set with two points do not change but the values for A_L and A_H change.

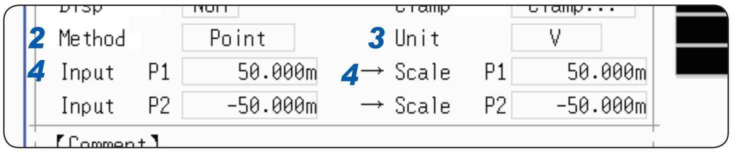
Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Each Ch]** sheet.



【Scaling】
Disp NUM
Method Ratio
Ratio 500.00
Clamp Clamp...
Unit V
Offset 0.0000

Display when [Method] is set to **[Ratio]**



Method Point
Unit V
Input P1 50.000m → Scale P1 50.000m
Input P2 -50.000m → Scale P2 -50.000m

Display when [Method] is set to **[Point]**

1 Enable the Scaling function.

Move the cursor to **[Disp]**.

Off	No scaling.
NUM	Displayed as a decimal and includes a unit (m, k, etc.).
SCI	Displayed as an exponent (power of ten)

2 Select the scaling conversion method.

Move the cursor to **[Method]**.

Ratio	Specify by conversion ratio.
Point	Specify by two points.

3 Specify the physical units.

Move the cursor to **[Unit]**, and enter the physical unit name. (Up to 7 characters)
Refer to “Entering Text” (p. 149).

Input example:
Decimal 1.2345 mV
Exponent 1.2345E−03 V

4 Enter the numerical values for conversion.

When you have selected [Ratio]

(Set conversion ratio and offset)

Move the cursor to and enter values for **[Ratio]** and **[Offset]**.

Enter numerical values in each field.

−9.9999E+9 to 9.9999E+9

Refer to “Alphanumeric Input” (p. 149).

When you have selected [Point]

(Set input values for two points and the values after conversion)

Move the cursor to and enter values for **[Input P1]**, **[Scale P1]**, **[Input P2]**, and **[Scale P2]**.

Enter numerical values in each field.

−9.9999E+9 to 9.9999E+9

Refer to “Alphanumeric Input” (p. 149).

- When saving text or the results of numerical calculation, some characters and symbols used for display on the instrument will be converted as follows.
  (“MR8827 display” to “saved string”)
- ^{2} to ^2, ^{3} to ^3, µ to ~u, Ω to ~o, ε to ~e, ° to ~c, ± to ~+

To enter the current input value as is for P1 or P2
Select **[Monitor Val]**.

To reset scaling settings

Move the cursor to **[Setting]**, and select **[Reset]**.

To copy the scaling setting to another channel

The Channel screen - **[Scaling]** sheet can be used to copy a setting.
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169)

To use a combination of the Scaling and Variable functions (p. 164)

The full span of output from a sensor can be displayed. (p. 166)

At factory shipping, automatic correction of the variable function (p. 315) is set to **[On]**.
At this time, the Variable setting is altered so that it is linked to (dependent upon) the vertical axis (voltage axis) range and scaling settings.
If you want the Variable function setting to take priority, use either of the following procedures:

- Set Scaling first, then set the Variable function
- Set a Variable value before Scaling, then set Scaling.

When automatic correction of the Variable function (variable auto-adjustment) is disabled **[Off]**, the Scaling and Variable settings are unlinked (independent of one another).

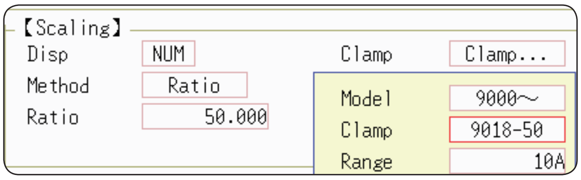
8.5.1 Scaling Examples

When using the clamp sensor

Example 1

Measure with the 10 A range of the Model 9018-50 Clamp on Probe and display the measured data in units of [A] (Amperes)

The 9018-50 Clamp on Probe provides 0.2 V output when measuring 10 A. So Scaling should be set to display 10 A with 0.2 V input (and 0 A with 0 V input).



【Scaling】
Disp NUM
Method Ratio
Ratio 50.000
Clamp Clamp...
Model 9000~
Clamp 9018-50
Range 10A

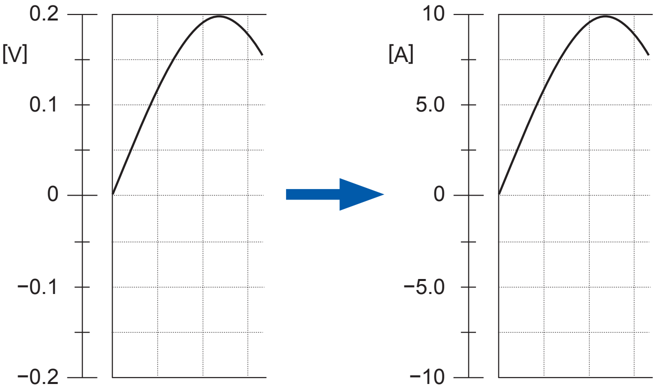
Setting	Selection
Set	NUM or SCI
Clamp	9018-50
Unit*	A
Method*	Ratio
Ratio*	50.000

*: Set automatically when clamp sensor is selected.

To Select a Clamp Sensor

1. Move the cursor to **[Clamp]**, and select **[Select]**.
   The cursor moves to **[Model]**.
2. Select **[9000~]**.
   The cursor moves to **[Clamp]**.
3. Select **[9018-50]** from the clamp list with **F** key, and select **[Confirm]**.
   Units, scaling method, and ratio will be set automatically.
4. Select the same range of the clamp sensor when using the range selection type. Select **[10A]** here.

However, you may need to switch the vertical axis (voltage axis) range to suit actual input values. For example, to display 0.2 V at full scale, set the vertical display to 20 mV per division (the instrument's 20 mV/div range)



Before Scaling

After Scaling

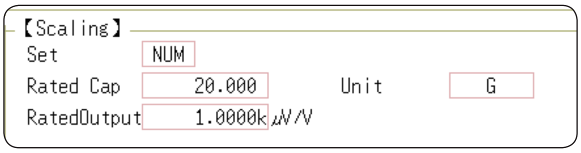
With scaling, signals from the sensor are acquired as current rather than voltage. AB cursors and gauges are displayed and printed as current (Ampere) values. Refer to “Gauge” (p. 122) or “Cursor AB Value” (p. 115).

When using Model 8969 or U8969 Strain Unit

Example 2

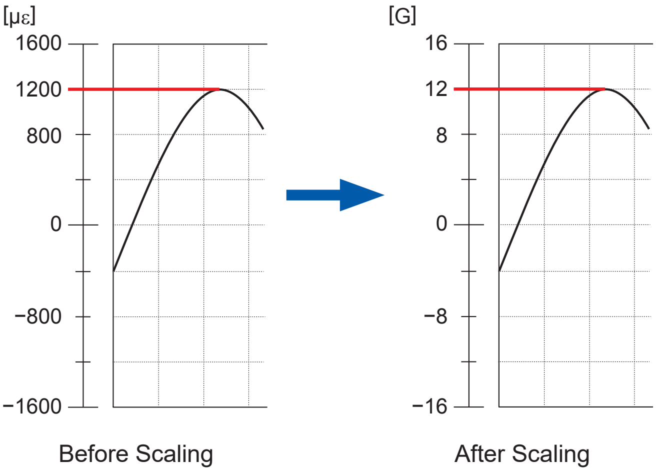
To display data measured with the strain gauge transducer with a rated capacity of 20 G and a rated output of 1000 μV/V in terms of gees (G).

For the rated capacity and rated output, consult the inspection record of the strain gauge transducer to be used. Set the rated capacity and rated output so that the following expression holds:



【Scaling】
Set NUM
Rated Cap 20.000 Unit G
RatedOutput 1.0000k μV/V

Setting	Selection
Set	NUM
Unit	G
Rated Cap (Rated capacity)	20.000
Rated Output	1.0000k



Scaling signals from the strain gauge transducer enabled them to be displayed as physical values.
Values at the Cursors A and B and gauges are displayed and printed as physical values.
Refer to “Gauge” (p. 122) or “Cursor AB Value” (p. 115).

Set the parameters such that the rated capacity divided by two times the rated output is less than or equal to 9.9999×10^9.

When the strain gauge transducer’s inspection record provides the calibration factor

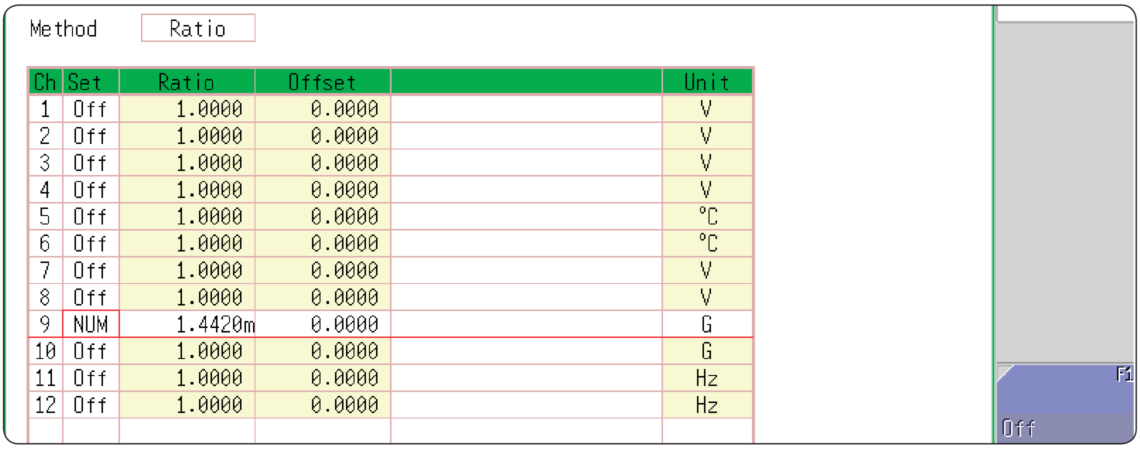
Set **[Method]** on the **[Scaling]** sheet to **[Ratio].**

Example 3

To display the data measured with the strain gauge transducer with a calibration factor of 0.001442 G / 1 × 10–6 strain* in terms of gees (G).

The value of the calibration factor (0.001442 [G]) is set as the conversion ratio.
(* 10^{-6} strain = $\mu\varepsilon$)
Move the cursor to the appropriate channel, and set as follows.

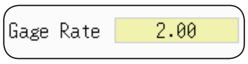
Setting	Selection
Se	NUM
Unit	G
Ratio (Conversion ratio)	0.001442 [G] (Displays as 1.4420m)



Method Ratio

Ch	Set	Ratio	Offset		Unit
1	Off	1.0000	0.0000		V
2	Off	1.0000	0.0000		V
3	Off	1.0000	0.0000		V
4	Off	1.0000	0.0000		V
5	Off	1.0000	0.0000		°C
6	Off	1.0000	0.0000		°C
7	Off	1.0000	0.0000		V
8	Off	1.0000	0.0000		V
9	NUM	1.4420m	0.0000		G
10	Off	1.0000	0.0000		G
11	Off	1.0000	0.0000		Hz
12	Off	1.0000	0.0000		Hz

Using a Strain Gauge With a Gauge Rate Other Than 2.0



Gage Rate 2.00

This value cannot be changed.

The Model 8969 or U8969 Strain Unit measures the gauge rate as 2.0. When using other strain gauges, the gauge rate needs to be set as the conversion ratio.
For example, if the gauge rate is 2.1, the conversion ratio is 0.952 (≈2/2.1).

Example 4

Measure using a strain gauge (gauge rate: 2.1), and display the measured data in units of G.

The scaling (conversion ratio) needs to be calculated to include both gauge rate and physical value conversions. In this case, the conversion ratio setting is the product of the conversion ratios of the gauge rate and measurement unit scaling.

The gauge rate component of the conversion ratio is 0.952, and the physical value component is 0.001442*
Conversion Ratio = 0.952 × 0.001442 = 0.0013728

As in Example 3, enter **[0.0013728]** as the conversion ratio.
To convert measurement values to physical values when using a strain gauge, calculate using the Young's modulus or Poisson's ratio of the measurement object. The conversion method depends on the conditions in which the strain gauge is used.
Refer to “Appendix 2.5 Scaling Method for Strain Gauges” (p. A8).

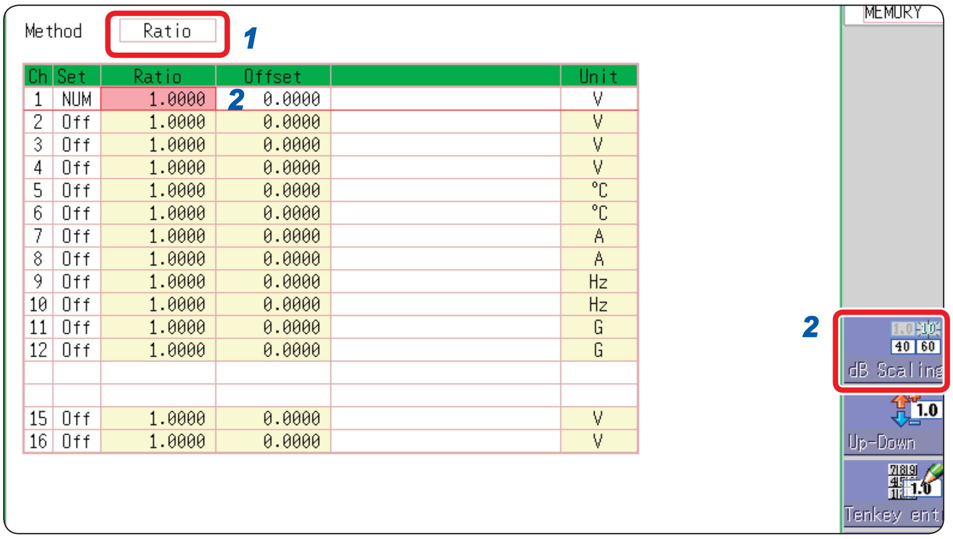
When using the dB value

Example 5

Acquiring the conversion rate to convert 40 dB input to 60 dB

1 **For scaling, set the [Method] to [Ratio].**

2 **Move the cursor to the conversion rate setting. Select [dB Scaling] in the function column.**



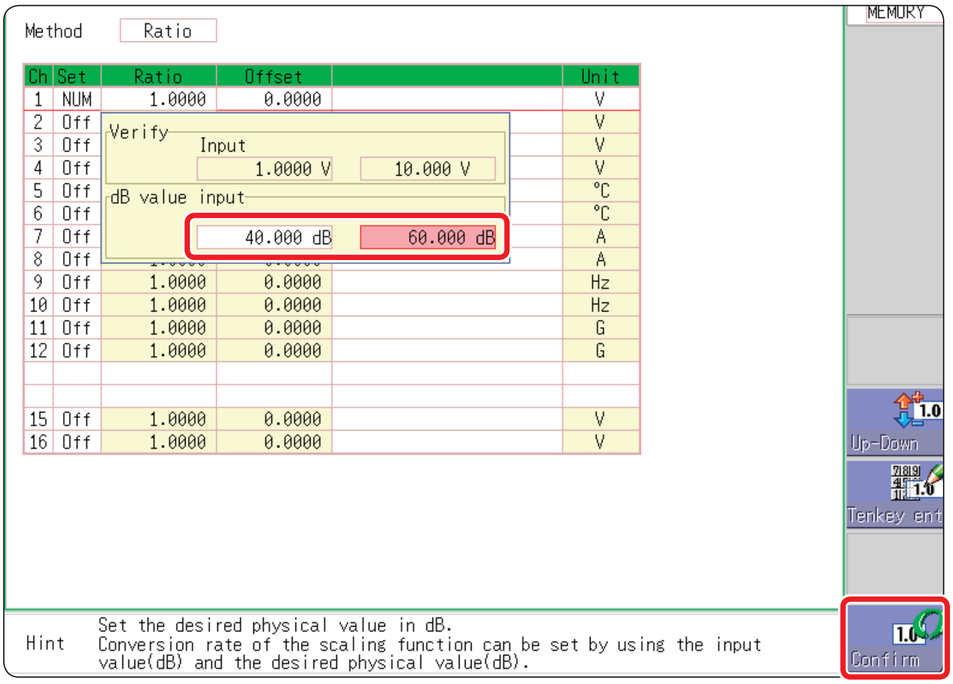
Method Ratio

Ch	Set	Ratio	Offset		Unit
1	NUM	1.0000	0.0000		V
2	Off	1.0000	0.0000		V
3	Off	1.0000	0.0000		V
4	Off	1.0000	0.0000		V
5	Off	1.0000	0.0000		°C
6	Off	1.0000	0.0000		°C
7	Off	1.0000	0.0000		A
8	Off	1.0000	0.0000		A
9	Off	1.0000	0.0000		Hz
10	Off	1.0000	0.0000		Hz
11	Off	1.0000	0.0000		G
12	Off	1.0000	0.0000		G
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

3 **In the displayed entry field and physical quantity field, enter 40 dB and 60 dB, respectively.**

4 **After entering the values, select [Confirm].**

Refer to “8.1.3 Alphanumeric Input” (p. 149).



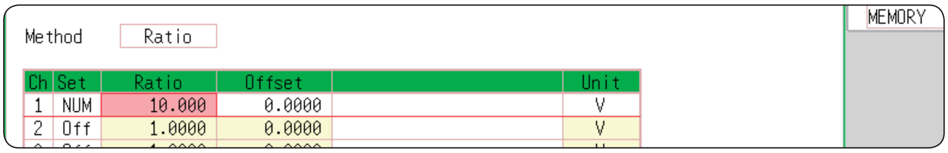
Method Ratio

Ch	Set	Ratio	Offset		Unit
1	NUM	1.0000	0.0000		V
2	Off				V
3	Off				V
4	Off				V
5	Off				°C
6	Off				°C
7	Off				A
8	Off				A
9	Off	1.0000	0.0000		Hz
10	Off	1.0000	0.0000		Hz
11	Off	1.0000	0.0000		G
12	Off	1.0000	0.0000		G
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

Verify
Input
1.0000 V 10.000 V
dB value input
40.000 dB 60.000 dB

Hint Set the desired physical value in dB.
Conversion rate of the scaling function can be set by using the input value(dB) and the desired physical value(dB).

The conversion rate for the entered dB value will be entered.
(The offset becomes 0.)



Method Ratio

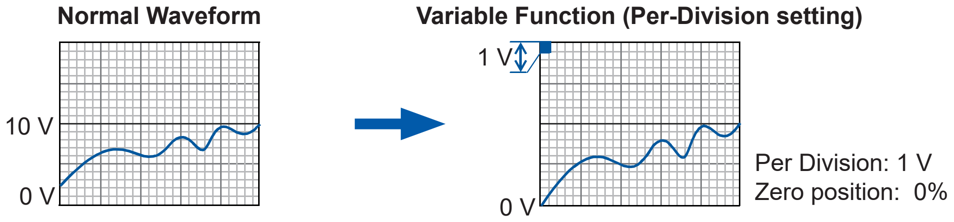
Ch	Set	Ratio	Offset		Unit
1	NUM	10.000	0.0000		V
2	Off	1.0000	0.0000		V

8.6 Set the Waveform Position (Variable Function)

The waveform height and display position can be arbitrarily set along the vertical axis (voltage axis).

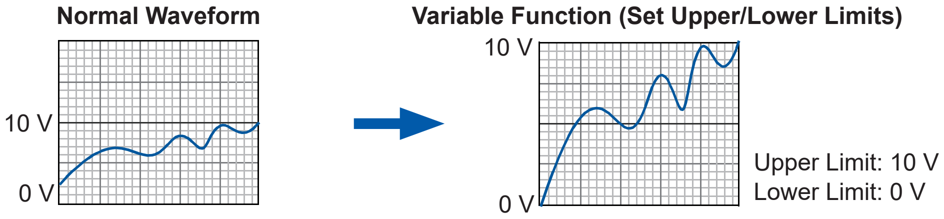
Precautions when using the Variable Function
- Verify that the vertical axis (voltage axis) range is set properly for the input signal.
- The vertical axis (voltage axis) range is unaffected by changes to the upper and lower limits made by the Variable setting.

The following two setting methods are available:
- **Set the displayed amplitude per division (1 div setting)**
  Set the amplitude to be displayed per vertical division and the zero position of the waveform on the vertical axis (voltage axis).



Per Division: 1 V
Zero position: 0%

- **Set the Upper and Lower Limits (Upper-Lower setting)**
  The upper and lower limits on the vertical axis (voltage axis) can be set to display the waveform amplitude full-screen.



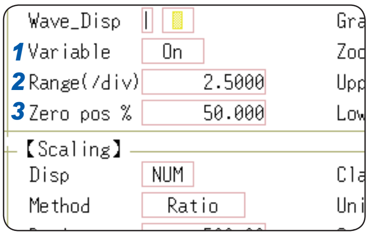
Upper Limit: 10 V
Lower Limit: 0 V

Settings for the Variable function can be made for each individual channel, using the **[Each Ch]** sheet accessed from the Channel screen (p. 165), or for all channels using the Display range window (p. 166).

Variable Function Settings per Channel

Procedure

Press the **CHAN** key to open the Channel screen, and then select the **[Each Ch]** sheet.



Wave_Disp

1 Variable On

2 Range(/div) 2.5000

3 Zero pos % 50.000

【Scaling】

Disp NUM

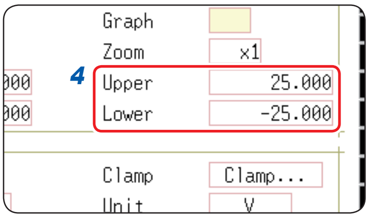
Method Ratio

1 **Enable the Variable function.**

Move the cursor to **[Variable]**, and select **[On].**

2 **Set the display range per division**

Move the cursor to **[Range(div)]**, and enter a numerical value.
(Measurement units depend on the measurement mode of the module.)
(When this is changed, the upper/lower limit values for the display also change accordingly.)



Graph

Zoom x1

4 Upper 25.000

Lower -25.000

Clamp Clamp...

Unit V

3 **Set the waveform zero position to display on the vertical axis (vertical axis).**

Move the cursor to **[Zero pos%]**, and enter a numerical **[%]** value.
(When this is changed, the upper/lower limit values for the display also change accordingly.)

4 **(When setting upper and lower values)**

Move the cursor to **[Upper]** and **[Lower]**, and specify the values.
(When these are changed, the display range and zero position values also change accordingly.)

- When upper and lower values are set, waveforms can be displayed at full span on the screen.
- Depending on the scaling setting, the upper and lower display values may be less than 1. In such cases, set **[Variable]** to **[On]** then select **[Auto Set]**.
  Easy-to-read upper and lower limit values are set based on the current set values.

To reset the settings

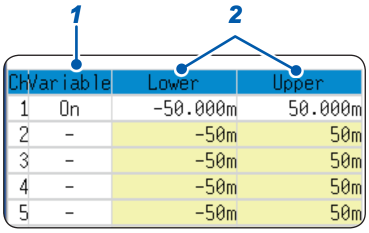
Select **[Reset]** to return the settings to their default values.

- For information on numeric input, refer to “8.1.3 Alphanumeric Input” (p. 149).
- The **[Unit List]** sheet accessed from the Channel screen also lets you turn the Variable function On or Off individually for each channel.
- By using the Scaling and Variable functions together, the full span of a sensor's output can be displayed. (p. 166)
- When Scaling is enabled, values are displayed in scaling units. When these settings are changed, the numerical values indicating the display range on the level monitor are changed accordingly.

Variable Function Settings for All Channels

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the display range window.



Ch	Variable	Lower	Upper
1	On	-50.000m	50.000m
2	-	-50m	50m
3	-	-50m	50m
4	-	-50m	50m
5	-	-50m	50m

1. **Enable the Variable function.**

   Move the cursor to **[Variable]**, and select **[On]**.

2. **Set the upper and lower limits.**

   Move the cursor to **[Upper]** and **[Lower]** and enter numerical values.

When Using the Scaling and Variable Functions Together

When auto-correction of the variable function (p. 315) is enabled (On) *(Default setting)*

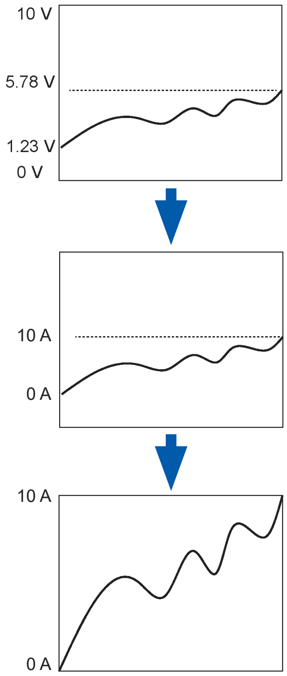
The Variable function settings change according to Scaling and vertical axis (voltage axis) range settings.
Set Scaling before setting the Variable function.
If you change Scaling settings after enabling the Variable function, the Variable setting voltage is automatically corrected so that the displayed size of waveforms is unchanged.

When auto-correction of the Variable function is disabled (Off)

Set the Variable function after setting Scaling.
If you set the Variable function first, enter post-scaling values (converted physical values).

To display the full span of output from a sensor

By using the Scaling and variable functions in combination, voltage from a sensor can be converted to the physical units of the measurement object.



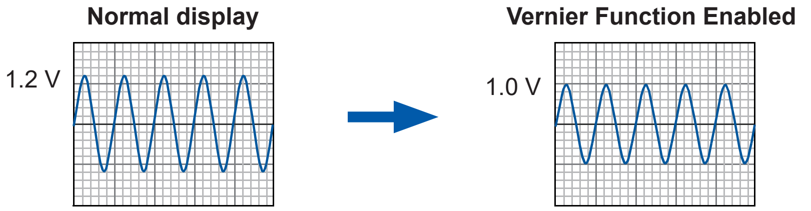
(Example)
Set Scaling as follows:
Scaling: Decimal or exponent, Two-Point Setting
Units: A
Sensor Output (Input 1): 1.23 [V]→(Scale 1): 0 [A]
Sensor Output (Input 2): 5.78 [V]→(Scale 2): 10 [A]

(With Variable function Off)
Voltage from the sensor is displayed as voltage.
It is displayed with the vertical axis (voltage axis) range and at the zero position set on the Channel settings window (**[Analog]** sheet).

The Variable function is set as follows:
Variable: On, Set Upper/Lower Limits
Lower Limit: 0 [A] Upper Limit: 10 [A]
The full span of output from the sensor is displayed.

8.7 Fine Adjustment of Input Values (Vernier Function)

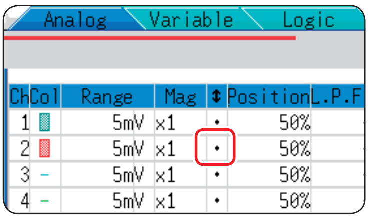
Fine adjustment of input voltage can be performed arbitrarily on the Waveform screen. When recording physical values such as noise, temperature and acceleration using sensors, amplitude can be adjusted to facilitate calibration.



1.2 V input is displayed as 1.0 V

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the channel settings window (**[Analog]** sheet).



Ch	Col	Range	Mag	↕	Position	L.P.F
1	🟩	5mV	x1	•	50%	
2	🟥	5mV	x1	•	50%	
3	-	5mV	x1	•	50%	
4	-	5mV	x1	•	50%	

1 **Move the cursor to the [↕] vernier setting of the channel you want to adjust.**

2 **Make the adjustment with the F keys while watching the waveform.**

Vernier↑	Magnify waveform
Vernier↓	Compress waveform
Vernier Reset	Return waveform to original position

- The adjustment range is 50 to 200% of the original waveform. The magnification/compression ratio is not displayed.
- Vernier adjustments cannot be verified on printed waveforms or lists.
- The waveform data (print data, saved file data) is adjusted by the Vernier function.

8.8 Invert the Waveform (Invert Function)

This applies to analog channels only. You can invert the positive and negative sides of waveforms.

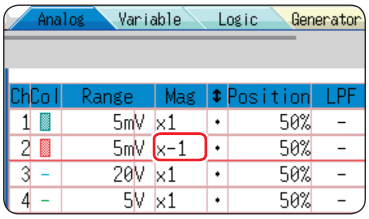
Example:
- When a current sensor is clamped around a wire with its current direction mark mistakenly in the direction opposite to the current flow
- When a signal is inputted with spring-pulling force negative and spring-compressing force positive; however, you would like to display the results with spring-pulling force positive and spring-compressing force negative

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the channel settings window (**[Analog]** sheet).

1 **Move the cursor to [Mag] for the channel whose waveform you want to invert.**

2 **Select [Invert].**



Ch	Col	Range	Mag	↕	Position	LPF
1	🟩	5mV	x1	•	50%	-
2	🟥	5mV	x-1	•	50%	-
3	-	20V	x1	•	50%	-
4	-	5V	x1	•	50%	-

The waveform data (print data, saved file data) will be adjusted by the Invert function.

8.9 Copy Settings to Other Channels (Copy Function)

Settings can be copied to other channels and calculations (When using the FFT function) at the following screens.

- Channel settings window
- Display range window
- Trigger settings window
- Status screen-**[Status]** sheet- [Analysis] list and [Scale] list (With FFT function only)
- Status screen - **[Num Calc]** sheet
- Status screen - **[Wave Calc]** sheet
- Channel screen - **[Unit List]** sheet
- Channel screen - **[Scaling]** sheet
- Channel screen - **[Comment]** sheet

The procedure below explains how to copy settings from the Display range window. The same procedure can be used for calculations as well as channels.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **CH.SET** key to open the display range window.

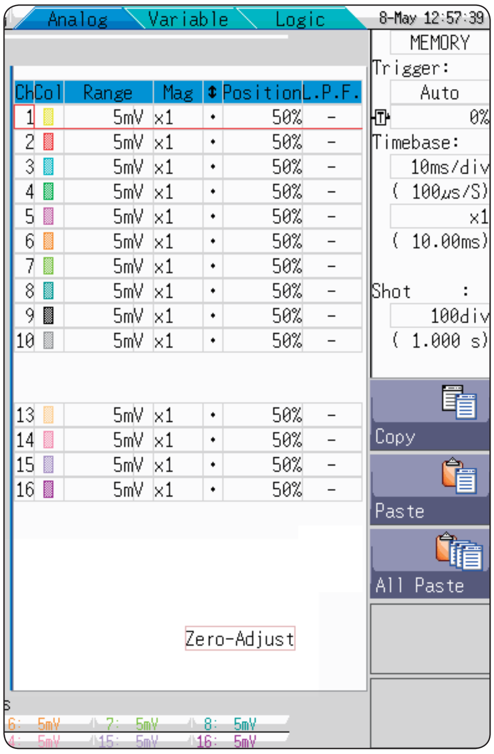
1 **Move the cursor to the copy source channel number (calculation No.).**

2 **Select [Copy].**

3 **Move the cursor to the channel number (calculation No.) where you want to paste the settings.**

4 **Select [Paste].**

To copy to all channels (calculations), move the cursor to a channel number (calculation No.) other than the copy source and select **[All Paste]**.
When you want to copy all the settings on the Unit list/ Scaling/Variable sheets, select the **[All setting Paste]** button or **[All setting All paste]** button.



Ch	Col	Range	Mag	↕	Position	L.P.F.
1	🟨	5mV	x1	•	50%	-
2	🟥	5mV	x1	•	50%	-
3	🟦	5mV	x1	•	50%	-
4	🟩	5mV	x1	•	50%	-
5	🟪	5mV	x1	•	50%	-
6	🟧	5mV	x1	•	50%	-
7	🟩	5mV	x1	•	50%	-
8	🟦	5mV	x1	•	50%	-
9	⬛	5mV	x1	•	50%	-
10	⬜	5mV	x1	•	50%	-
13	🟧	5mV	x1	•	50%	-
14	🟥	5mV	x1	•	50%	-
15	🟪	5mV	x1	•	50%	-
16	🟪	5mV	x1	•	50%	-

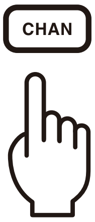
MEMORY
Trigger:
Auto
0%
Timebase:
10ms/div
(100µs/S)
x1
(10.00ms)
Shot :
100div
(1.000 s)

When channel settings are copied among different model modules, settings other than scaling cannot be copied. (Scaling copy is possible.)

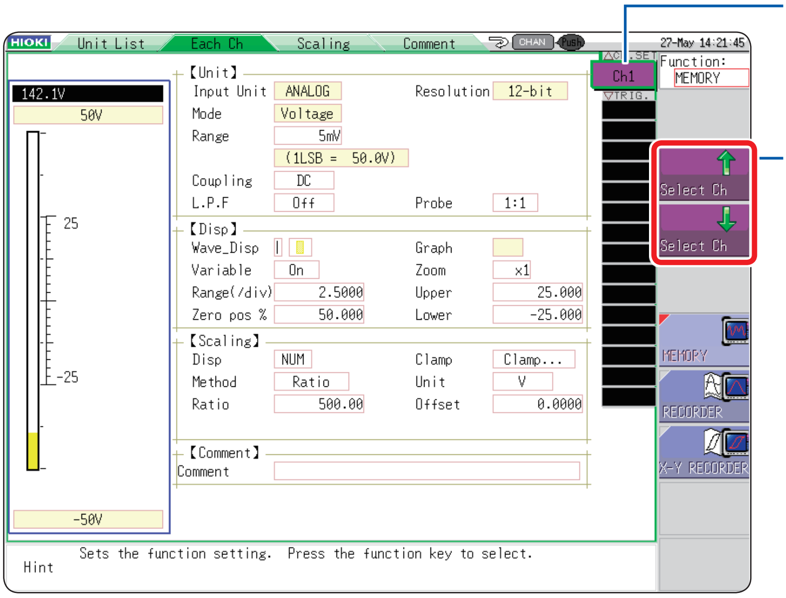
8.10 Detailed Settings for Modules

Using the **[Each Ch]** sheet accessed from the Channel screen, you can make detailed settings for each module.

To Open [Each Ch] and Make a Channel Selection



Press this key.



Function: MEMORY

【Unit】
Input Unit ANALOG Resolution 12-bit
Mode Voltage
Range 5mV
(1LSB = 50.0V)
Coupling DC
L.P.F Off Probe 1:1

【Disp】
Wave_Disp
Graph
Variable On Zoom x1
Range(/div) 2.5000 Upper 25.000
Zero pos % 50.000 Lower -25.000

【Scaling】
Disp NUM Clamp Clamp...
Method Ratio Unit V
Ratio 500.00 Offset 0.0000

【Comment】
Comment

Hint Sets the function setting. Press the function key to select.

Shows the channel number and channel position.

Select the channel.

Logic channel allocation when using Standard LOGIC terminals

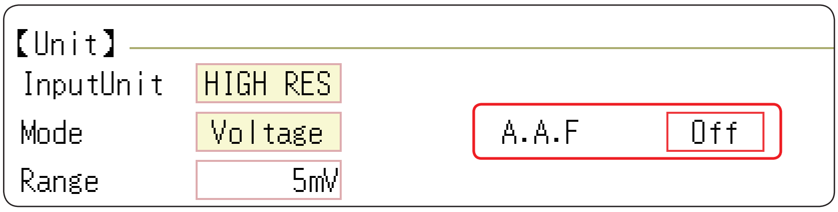
	Module	Memory for each channel (16 bits)			
		4 bit	4 bit	4 bit	4 bit
CH1*	Analog	Analog CH1			LA
CH2*		Analog CH2			LB
CH3*	Logic	L2A	L2B	—	LC
CH4*		L2C	L2D		LD
CH5	Analog	Analog CH5			
CH6		Analog CH6			
CH7	Logic	L4A	L4B	—	
CH8		L4C	L4D		
CH9	Analog	Analog CH9			
CH10		Analog CH10			
CH11	Analog	Analog CH11			
CH12		Analog CH12			
CH13	Analog	Analog CH13			
CH14		Analog CH14			
CH15	Analog	Analog CH15			
CH16		Analog CH16			
CH17	Analog	Analog CH17			LE
CH18		Analog CH18			LF
CH19	Analog	Analog CH19			LG
CH20		Analog CH20			LH
CH21	Analog	Analog CH21			
CH22		Analog CH22			
CH23	Analog	Analog CH23			
CH24		Analog CH24			
CH25	Analog	Analog CH25			
CH26		Analog CH26			
CH27	Analog	Analog CH27			
CH28		Analog CH28			
CH29	Analog	Analog CH29			
CH30		Analog CH30			
CH31	Analog	Analog CH31			
CH32		Analog CH32			

- CH1 to CH4 and CH17 to CH20 provide 12-bit precision when logic channels LA to LH are used. When Model 8970 Freq Units are installed as CH1 to CH4 and CH17 to CH20 and standard logic channels LA to LH are in use, the modules of corresponding channels cannot be used. When Model MR8990 Digital Voltmeter Units are installed as CH1 to CH4 and CH17 to CH20, the standard logic channels corresponding to the table above cannot be used.

8.10.1 Settings for the Anti-Aliasing Filter (A.A.F) [MEM]

The anti-aliasing filter (A.A.F) setting is configurable for Model 8968 High Resolution Unit and Model U8979 Charge Unit only.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



【Unit】

InputUnit HIGH RES

Mode Voltage

Range 5mV

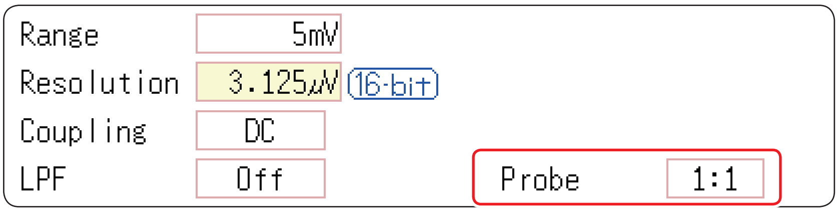
A.A.F Off

A.A.F Enable the anti-aliasing filter to remove aliasing distortion. The cutoff frequency automatically changes according to the timebase or, when the FFT function is used, the frequency range setting.

Off	The anti-aliasing filter is disabled. (*Default setting*)
On	The anti-aliasing filter is enabled. (When external sampling is used, the antialiasing filter (AAF) is not available.)

8.10.2 Probe Attenuation Selection

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



Range 5mV

Resolution 3.125μV (16-bit)

Coupling DC

LPF Off

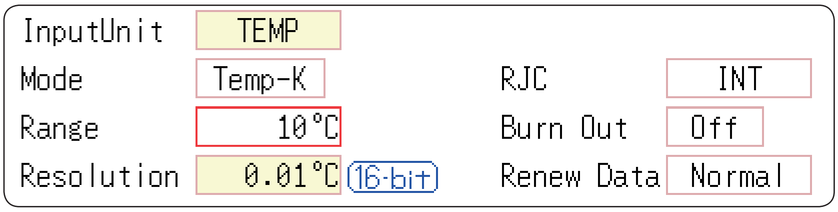
Probe 1:1

Probe Set this when performing measurement with a connection cable or probe.

1:1	Model L9197, L9198 or L9217 Connection Cord connected to the input module. (*Default setting*)
10:1	Model 9665 10:1 Probe connected to the input module.
100:1	Model 9666 100:1 Probe, P9000-01/-02 Differential Probe connected to the input module.
1000:1	Model 9322 Differential Probe, P9000-01/-02 Differential Probe connected to the input module.

8.10.3 Setting Model 8967 Temp Unit

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



InputUnit TEMP
Mode Temp-K
Range 10°C
Resolution 0.01°C
RJC INT
Burn Out Off
Renew Data Normal

Mode Choose the option that matches the type of thermocouple being used.

Selections	Measurement range	Selections	Measurement range
Temp-K	−200°C to 1350°C	Temp-R	0°C to 1700°C
Temp-J	−200°C to 1100°C	Temp-S	0°C to 1700°C
Temp-E	−200°C to 800°C	Temp-B	400°C to 1800°C
Temp-T	−200°C to 400°C	Temp-W	0°C to 2000°C
Temp-N	−200°C to 1300°C		

RJC (Reference Junction Compensation) When connecting a thermocouple directly to the module, select **[Int]**. Reference junction compensation is performed within the module.
When connecting through a reference junction device (e.g., a 0°C control tank), select **[Ext]**.

INT	Reference junction compensation is provided within the module. *(Default setting)* (Measurement Accuracy: The sum of the accuracies of the temperature measurement and the reference junction compensation.)
EXT	Reference junction compensation is not provided within the module. (Measurement Accuracy: The accuracy of temperature measurement only)

Burn Out A broken thermocouple wire can be detected during temperature measurement. Normally when a thermocouple wire breaks, measured values exhibit random instability.

Off	Broken wires not detected.
On	Broken wires detected. Wire breakage is detected by sensing a miniscule current flow (about 100 nA) through the thermocouple. If the thermocouple wires are long or composed of a high-resistance material, set **[Burn Out]** to **[Off]** to avoid measurement errors.

Renew Data (Data Refresh) The data refresh rate can be set to Fast, Normal, or Slow.
The default setting is **[Normal]**. This allows stable measurement while eliminating noise. For quicker response, select **[Fast]**, but note that this will make the measurement more susceptible to noise. For further improved measurement stability, select **[Slow]**.

Fast	Data is updated approximately every 1.2 ms.
Normal	Data is updated approximately every 100 ms. *(Default setting)*
Slow	Data is updated approximately every 500 ms.

8.10.4 Setting Model 8969 and U8969 Strain Unit

The Model 8969 or U8969 Strain Unit can perform auto-balance.
Executing the auto-balance adjusts the reference output level of the transducer to the specified zero position.
This function can be used for Model 8969 or U8969 Strain Unit only.

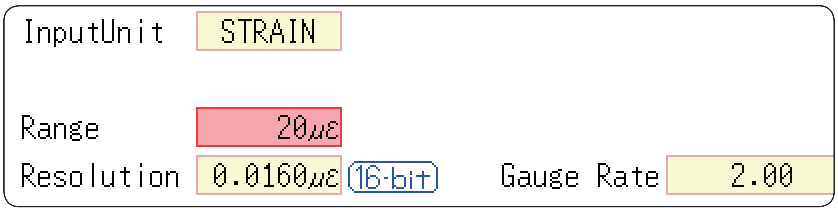
The instrument describes Model U8969 as “8969.”

Before Executing Auto-balance

- Turn power on and wait 30 minutes to allow the internal temperature of the module to stabilize.
- After connecting a strain gauge transducer to the module and a measuring target, execute the auto-balance without any input including distortion.
- Auto-balance cannot execute during measurement.
- Key operations are not accepted while auto-balance is executing.

To Execute Auto-balance

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



InputUnit STRAIN

Range 20με

Resolution 0.0160με 16-bit

Gauge Rate 2.00

Setting Item: **[Range]**

Auto Bal All Chs	Auto-balance will be executed for all channels where a Model 8969 or U8969 Strain Unit is installed.
Auto Bal Ch 1	Auto-balance will be executed for the currently selected channel.

Auto-balance can also be executed from the Channel settings window (Analog sheet) (if the range of a channel with an installed Model 8969 Strain Unit is selected).

To Open the Channel settings window ([Analog] sheet)
Refer to “3.4.2 Choose Analog Channel Settings” (p. 69).

In the following cases, auto-balance should be executed again.

- After changing the vertical axis (strain axis) range
- After a module has been removed or inserted
- After the strain gauge transducer has been replaced
- After power has been turned off and on
- After performing a system reset
- When ambient temperature has changed significantly (the zero position may drift)

If “Warning: Auto balance failed.” appears

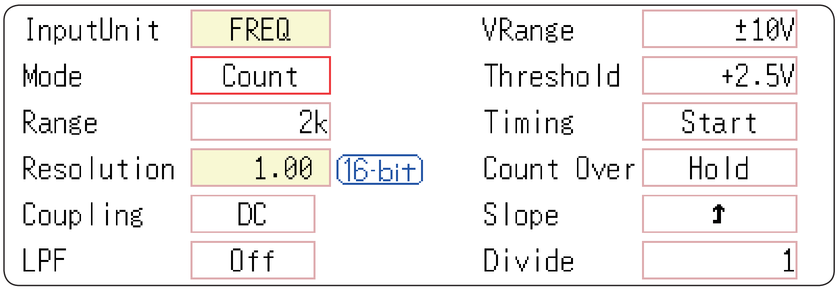
The channel on which auto-balance failed is displayed.
Verify the following, and execute again:

- Is the strain gauge transducer not subject to any load?
(Make sure that it is not subject to vibration, etc.)
- Is the strain gauge transducer correctly connected to a measuring target?

8.10.5 Setting Model 8970 Freq Unit

When the standard logic display (LA, LB, LC, LD, LE, LF, LG, and LH) is on, 8970 Freq Units installed as unit 1, 2, 9, or 10 cannot be used.

Refer to "To Open **[Each Ch]** and Make a Channel Selection" (p. 170).

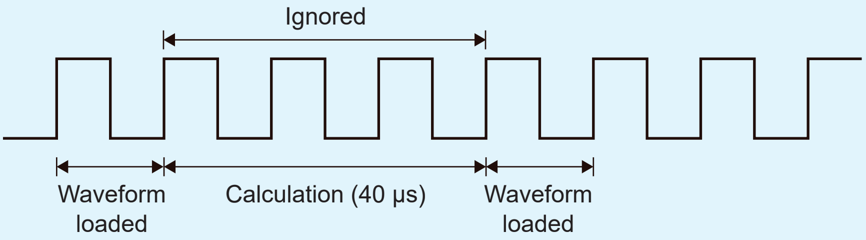


InputUnit	FREQ	VRange	±10V
Mode	Count	Threshold	+2.5V
Range	2k	Timing	Start
Resolution	1.00 16-bit	Count Over	Hold
Coupling	DC	Slope	↑
LPF	Off	Divide	1

Mode Changes the measurement mode.

Frequency	Measure the frequency of the measurement waveform (Hz hertz) *(Default setting)*
RPM	Measure the number of rotations of the measurement target (r/min: rotations/minutes)
Power Frequency	Measure the power frequency variation (Hz hertz)
Count	Add up the number of input pulses
Duty	Measure the duty rate of the measurement waveform (% percent)
Pulse width	Measure the pulse width (s second)

Pulses with rises during dead time (calculation) (25 kHz or higher) cannot be measured.



VRange (Input voltage) Set the maximum level for the input signal.

±10 V *(Default setting)*, **±20 V, ±50 V, ±100 V, ±200 V, ±400 V**

Select the value using the **F** keys.

Threshold value

- When the measurement waveform exceeds the threshold value, the measurement value is acquired based on the time interval and the number of times the threshold was exceeded.
- The threshold value upper and lower limits and increases and decreases in width depend on the input voltage ([VRange]) setting.
- While setting the threshold, the voltage level is displayed on the level monitor.
- Select the value using the **F** keys.

To prevent measurement errors due to noise, the threshold has a hysteresis of approximately 3% versus the input voltage.
(When **[VRange]** is **[±10V]**, it is around ±0.3 V.)
Set a threshold in excess of the hysteresis width versus the voltage peak.

Slope

For each measurement mode, set the direction in which the specified level is crossed.

↑	Rises above the specified level are detected. *(Default setting)*
↓	Drops below the specified level are detected.

Divide

Determines the frequency for each set pulse.

1*(Default setting)* to **4096**

Select the value using the **F** keys.

Example: When the encoder is at 360 pulses per rotation, the frequency of each rotation can be measured by setting the number of divisions to **[360]**. When frequency dividing is not needed, set to **[1]**.

Timing

This is enabled only when **[Mode]** is **[Count].**
Sets the start timing for the sum count.

Start	When the **START** key is pressed, counting starts. *(Default setting)*
Trigger	When a trigger is applied, counting starts.

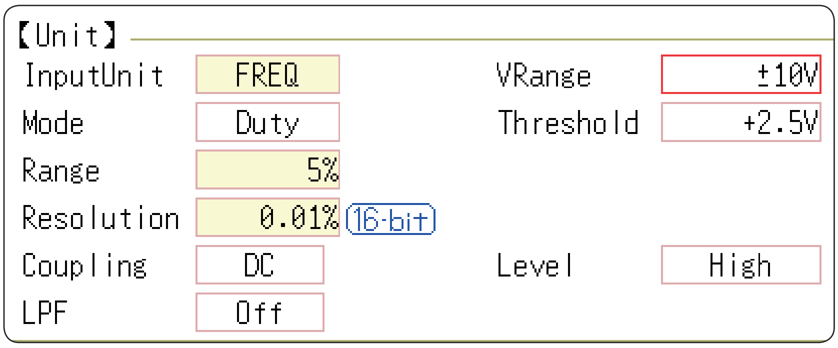
- When **[Start]** is set, there is some internal processing time between pressing of the **START** key and the start of measurement. Therefore, the count value is not zero at the start point.
- When **[Start]** is set and the trigger level is exceeded while waiting for the pre-trigger, the trigger is not enacted. Furthermore, the time for internal processing at start and the trigger priority setting may cause the trigger not to be enacted at the specified trigger level.
- When memory division is used, there are cases when the last data in the previous block remains in the first part of the block.

Count Over

This is enabled only when **[Mode]** is **[Count].**

Hold	Counting is performed to the maximum (at 2 k range, 65535) and no higher.
Back	If counting is performed up to 25 times the range (at 2 k range, up to 50000) the count value returns to 0.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



【Unit】

InputUnit FREQ

Mode Duty

Range 5%

Resolution 0.01% 16-bit

Coupling DC

LPF Off

VRange ±10V

Threshold +2.5V

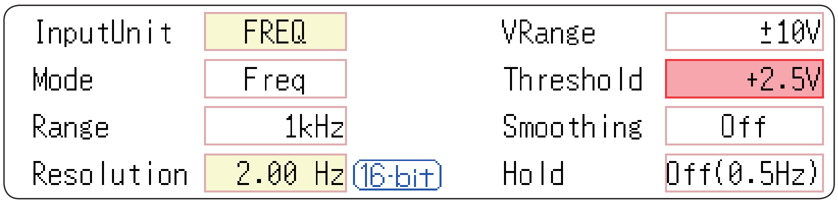
Level High

Level This is enabled only when **[Mode]** is **[Pulse Width]** or **[Duty].**

In pulse width/duty rate measurements, set which level is detected when the threshold is exceeded.

HIGH	Measures above the threshold value. *(Default setting)*
LOW	Measures below the threshold value.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



InputUnit FREQ

Mode Freq

Range 1kHz

Resolution 2.00 Hz 16-bit

VRange ±10V

Threshold +2.5V

Smoothing Off

Hold Off(0.5Hz)

Smoothing This is enabled only when **[Mode]** is **[Freq]** or **[RPM].**

Set smoothing.

Off	The measured data is recorded as is. (A step waveform.) *(Default setting)*
On	The measured data is interpolated so that the waveform is smooth before it is output. (Upper limit: 10 kHz, further delayed from Off.)

Hold This is enabled only when **[Mode]** is **[Freq]** or **[RPM].**

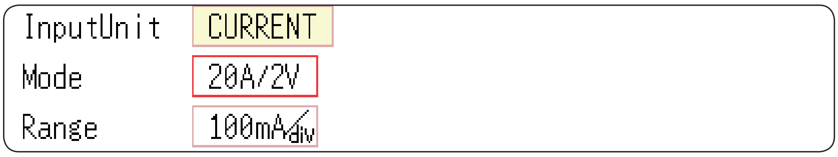
Set hold for frequency and count.

Off (1Hz/0.5Hz/ 0.2Hz/0.1Hz)	When the frequency reaches the value in the brackets but is not settled, it is defined as a stopped item and the measurement value becomes 0 Hz (0 rpm). *(Default setting)*
On	The value defined last time is retained.

8.10.6 Setting Model 8971 Current Unit

There is no need to change the setting since it is set when the clamp sensor is automatically recognized.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



InputUnit CURRENT
Mode 20A/2V
Range 100mA/div

Mode

20A/2V	Sets this option when Model 9272 (20 A range), 9277, or CT6841 Clamp Sensor is connected. (Default setting)
200A/2V	Sets this option when Model 9272 (200 A range), 9278, CT6863, or CT6843 Clamp Sensor is connected.
50A/2V	Sets this option when Model CT6862 Clamp Sensor is connected.
500A/2V	Sets this option when Model 9279, 9709, CT6844, CT6845, CT6846*, CT6865*, CT6875 or CT6876* Clamp Sensor is connected.

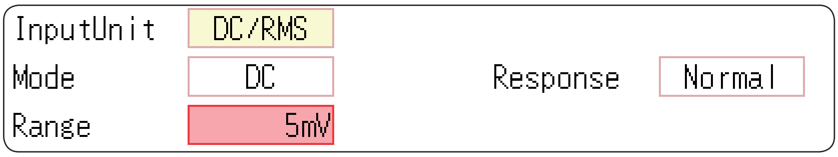
* When Model CT6846, CT6865 or CT6876 is connected to Model 8971 Current Unit through Model 9318 Conversion Cable (Model CT9901 Conversion Cable), the instrument recognizes that as an 500 A AC/DC sensor is connected; set the scaling ratio to 2.00.

Range

DC	Current measurement (*Default setting*)
RMS	RMS current measurement

8.10.7 Setting Model 8972 DC/RMS Unit

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



InputUnit DC/RMS
Mode DC
Range 5mV
Response Normal

Mode

Switches between voltage measurement and RMS measurement.

DC	Voltage measurement *(Default setting)*
RMS	RMS measurement

Response

The response time for RMS measurement can be set to three speeds: Fast, Normal and Slow.

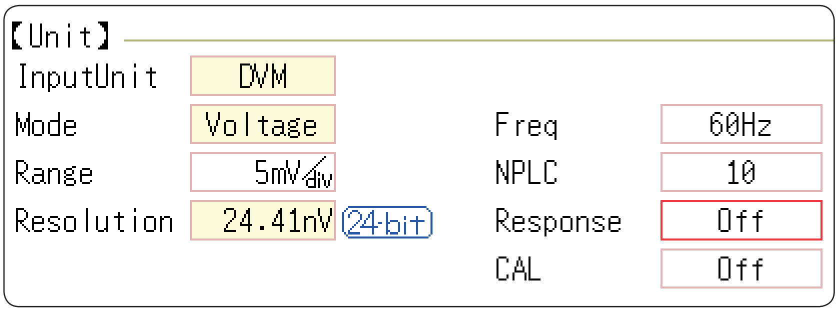
While it is normally set to **[Fast]**, this can be changed to **[Normal]** or **[Slow]** to stabilize the measured value when the frequency is low or when severe fluctuations are present.

Fast	Response time about 100 ms. *(Default setting)*
Normal	Response time about 800 ms.
Slow	Response time about 5 s.

8.10.8 Setting Model MR8990 Digital Voltmeter Unit

- When the Model MR8990 Digital Voltmeter Unit is installed as unit 1, 2, 9, or 10, the standard logic channels cannot be used.
- The resolution of the data measured by the recorder function is 16 bits.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



【Unit】

InputUnit: DVM

Mode: Voltage

Range: 5mV/div

Resolution: 24.41nV (24-bit)

Freq: 60Hz

NPLC: 10

Response: Off

CAL: Off

Frequency Set the power frequency.
Set 50 Hz or 60 Hz according to the power frequency for your region.

50Hz	Cycle 20 ms *(Default setting)*
60Hz	Cycle 16.67 ms

If the power frequency setting is not configured correctly, measurement values will be unstable.

NPLC PLC (Power Line Cycle) is the time equivalent to one cycle of the power frequency.
Set the integration time based on one PLC.

0.1 to 0.9, 1 (*Default setting*) **to 10, 20, 30, 40, 50, 60, 70, 80, 90, 100**

Example: When the power frequency is 50 Hz, and NPLC is set to 10, 20 ms × 10 = 200 ms.
The measurement data refresh rate becomes 200 ms.

Fast response Data can be refreshed at high speed.

Off	Refreshes data at the integration time set for NPLC. *(Default setting)*
On	Calculates the moving average and refreshes the data at high speed. Refreshes the data at 0.1 PLC when NPLC is up to 9. Refreshes the data at 1 PLC when NPLC is 10 or above.

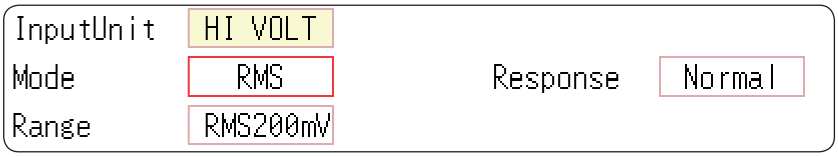
Calibration This setting is used for performing calibration or synchronization between channels automatically when measurement is started. Performing synchronization between channels enables matching the timing for the start of integration.

Off	No calibration and synchronization. *(Default setting)*
On	Perform calibration and synchronization.
Synchronization	Perform only synchronization between channels.

- The calibration time is approximately 150 ms. During this period measurement is not performed.
- If synchronization between channels is performed, a signal to stop integration is sent to each module when measurement is started and the wait process is performed until the first integration finishes. The wait time required for this process is (10 ms + integration time*).
  * The integration time varies depending on the NPLC setting.
  If synchronization is not performed, the above wait time will also be required for measurement performed immediately after the settings of the Model MR8990 Digital Voltmeter Unit are changed. However, there will be no wait time when measurement is performed with the same settings.
- When this is set to **[Off]** (Default setting), perform calibration manually.
  Refer to "2.8 Perform Calibration (When Model MR8990 is installed)" (p. 54).

8.10.9 Setting Model U8974 High Voltage Unit

Refer to: "To Open **[Each Ch]** and Make a Channel Selection" (p. 170)



InputUnit HI VOLT
Mode RMS
Range RMS200mV
Response Normal

Mode Switches between voltage measurement and RMS measurement.

DC	Voltage measurement (Default setting)
RMS	RMS measurement

Response The response time for RMS measurement can be set to three speeds: Fast, Normal and Slow.
The response time can be set to **[Slow]** to stabilize the measured value when the frequency is low or when severe fluctuations are present.

Fast	Response time is set to 150 ms.
Normal	Response time is set to 500 ms. (Default setting)
Slow	Response time is set to 2.5 s.

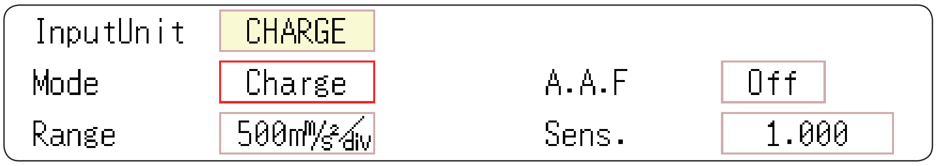
8.10.10 Setting Model U8979 Charge Unit

This setting allows you to choose between voltage measurement and acceleration measurement (charge-output or built-in pre-amplifier) for a channel.
A channel can measure either one of them.
[Voltage] mode and **[PreAmp]** mode use BNC connectors, whereas **[Charge]** mode uses miniature connectors.
Model U8979 can automatically recognize TEDS-compliant* sensors.
*: Transducer electronic data sheet

⚠WARNING

Setting the measurement mode to [PreAmp] allows Model U8979 Charge Unit to constantly provide power (3.0 mA, 22 V) to sensors. Set any measurement mode other than [PreAmp] or tum off the instrument before connecting a sensor or probe with a BNC terminal to avoid an electric shock or damage to the measurement target.

Refer to "To Open **[Each Ch]** and Make a Channel Selection" (p. 170)



InputUnit CHARGE
Mode Charge
A.A.F Off
Range 500m/s²/div
Sens. 1.000

Mode

Switches the measurement mode.

Mode	Measurement target	Measurement sensitivity
Voltage	Voltage	–
Charge (Default setting)	Charge-output acceleration sensor	0.1 pC/(m/s^2) to 10 pC/(m/s^2)
Preamp	Acceleration sensor with a built-in preamplifier	0.1 mV/(m/s^2) to 10 mV/(m/s^2)

(When setting mode to **[PreAmp]**)
Move the cursor to the **[Sens.]** box and execute **[TEDS Load]**.
Acquires sensitivity of a connected sensor. However, the instrument can acquire sensitivity of TEDS-compliant acceleration sensors with a built-in pre-amplifier only.
When sensor sensitivity has been acquired, it is automatically set.

A.A.F

The anti-aliasing filter can prevent aliasing distortion that may be produced during FFT calculation. The cutoff frequency automatically changes according to the sampling rates or frequency range (for the FFT function) settings.

OFF	Disables the anti-aliasing filter. (Default setting)
ON	Enables the anti-aliasing filter. (Disabled when the external sampling is used, or the sampling rate is set at 100 kS/s or faster)

Sensitivity

You can enter sensor sensitivity to two decimal places. For a charge-output acceleration sensor or non-TEDS-compliant sensor, enter its sensitivity marked on the sensor, which represents sensitivity per meter per second squared.

Setting example for sensor sensitivity

Example 1

For a sensor with its sensor sensitivity per meter per second squared marked

Sensor sensitivity	(setting value)
1.08 pC/(m/s^2)	1.08

Example 2

For a sensor with its sensor sensitivity per gee (G) marked.

For a sensor with its sensitivity marked, enter a quotient of the marked sensitivity divided by 9.8 m/s^2.

Sensor sensitivity	(setting value)
For sensor sensitivity of 64 pC/G 64.0 / 9.8 = 6.53061... pC/(m/s^2)	6.531 (to two decimal places)

To convert a unit from meter per second squared into gee (G)

The instrument measure charge quantities per meter per second squared. You can convert such charge quantities into those per gee (G) using the scaling function.
Refer to “8.5 Convert Input Values (Scaling Function)” (p. 157)

Configure the scaling setting as follows;

Example 1

Specifying a conversion ratio

Ratio	0.1020E+00 (= 1/9.8)
Offset	0.0000E+00
Units	G

Example 2

Specifying two points

Input1	9.8000E+00	Scale1	1.0000E+00
Input2	0.0000E+00	Scale2	0.0000E+00
Units	G		

When using an out-of-setting-range current sensor

You can use an out-of-setting-range current sensor using the scaling function.
Refer to “5.2.2 Automatically Save Waveforms” (p. 88)

Sensitivity	Multiply the sensor sensitivity of a sensor to be used by a certain value to allow a product to fall within the setting range (0.1 to 10), and enter the product.
Scaling	Configure the scaling setting so that a scaling ratio is the same value as the number you multiplied the sensor sensitivity by.

Example 1

For sensor sensitivity of 23.4 pC/(m/s^2)

Specify 10 pC/(m/s^2), which results from multiplying the sensor sensitivity by 1/2.34, as the sensor sensitivity. To display measured values after multiplying them by 1/2.34, configure the scaling setting as follows:

To configure the scaling setting using the conversion ratio method

Ratio	0.4274E+00 (= 10/23.4)
Offset	0.0000E+00
Units	m/s^2

To configure the scaling setting using the 2-point method

Input1	2.3400E+00	Scale1	1.0000E+00
Input2	0.0000E+00	Scale2	0.0000E+00
Units	m/s^2		

Example 2

For sensor sensitivity of 0.05 pC/(m/s^2)

Specify 0.1 pC/(m/s^2), which results from multiplying the sensor sensitivity by two, as the sensor sensitivity. To display measured values after multiplying them by two, configure the scaling setting as follows:

To configure the scaling setting using the conversion ratio method

Ratio	2.0000E+00 (= 0.1/0.05)
Offset	0.0000E+00
Units	m/s^2

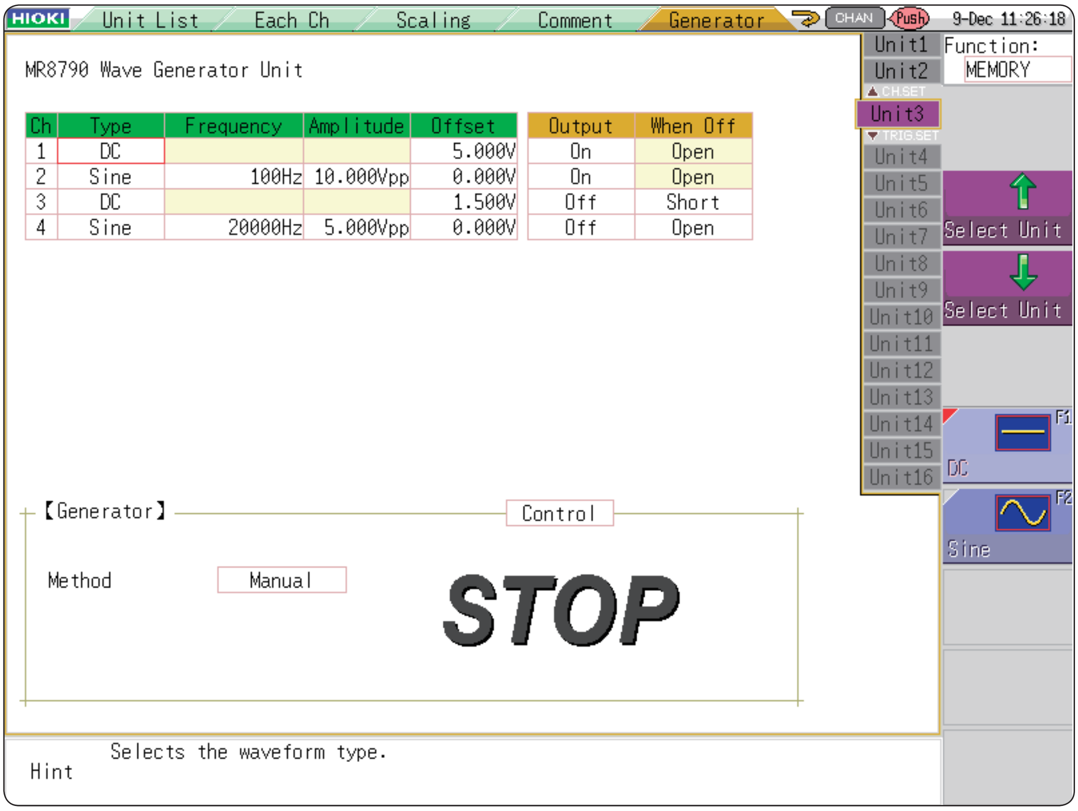
To configure the scaling setting using the 2-point method

Input1	0.0500E+00	Scale1	1.0000E+00
Input2	0.0000E+00	Scale2	0.0000E+00
Units	m/s^2		

8.10.11 Setting Model MR8790 Waveform Generator Unit

Channels installed with Model MR8790 cannot be measured.

Refer to “To Open **[Each Ch]** and Make a Channel Selection” (p. 170).



Function: MEMORY

MR8790 Wave Generator Unit

Ch	Type	Frequency	Amplitude	Offset	Output	When Off
1	DC			5.000V	On	Open
2	Sine	100Hz	10.000Vpp	0.000V	On	Open
3	DC			1.500V	Off	Short
4	Sine	20000Hz	5.000Vpp	0.000V	Off	Open

【Generator】 Control

Method Manual

Hint Selects the waveform type.

Type Selects the waveform type.

DC	DC output (Default setting)
Sine	Sine wave output

Frequency Sets the frequency of output signal.

0 Hz to 20000 Hz

Amplitude Sets the amplitude of output signal.
The output voltage with guaranteed accuracy is the sum of the amplitude and the offset, between -10 V and +10 V. If the sum of the amplitude and the offset is set outside the guaranteed accuracy range, parts of the waveform will be clamped to the upper limit, approximately +14 V and the lower limit, approximately -14 V.

0.000 V p-p to 20.000 V p-p

Offset

For DC output: Sets DC voltage.
For sine wave output: Sets the offset voltage.
The output voltage with guaranteed accuracy is the sum of the amplitude and the offset, between -10 V and +10 V. If the sum of the amplitude and the offset is set outside the guaranteed accuracy range, parts of the waveform will be clamped to the upper limit, approximately +14 V and the lower limit, approximately -14 V.

-10 V to +10 V

When Off

Sets the terminal status when the output is off.

Open	Opens the output terminals, separating them from internal circuits.
Short	Short-circuits the output terminals, separating them from internal circuits.

Output

Turns waveform output On/Off.

On	Outputs waveform.
Off	Does not output the waveform.

Control

Sets the waveform output.

RUN	Starts output.
PAUSE	Pauses output. While output is paused, the output at the time [PAUSE] was pressed will be output.
STOP	Stops output.

Method

Selects the control method for waveform output.

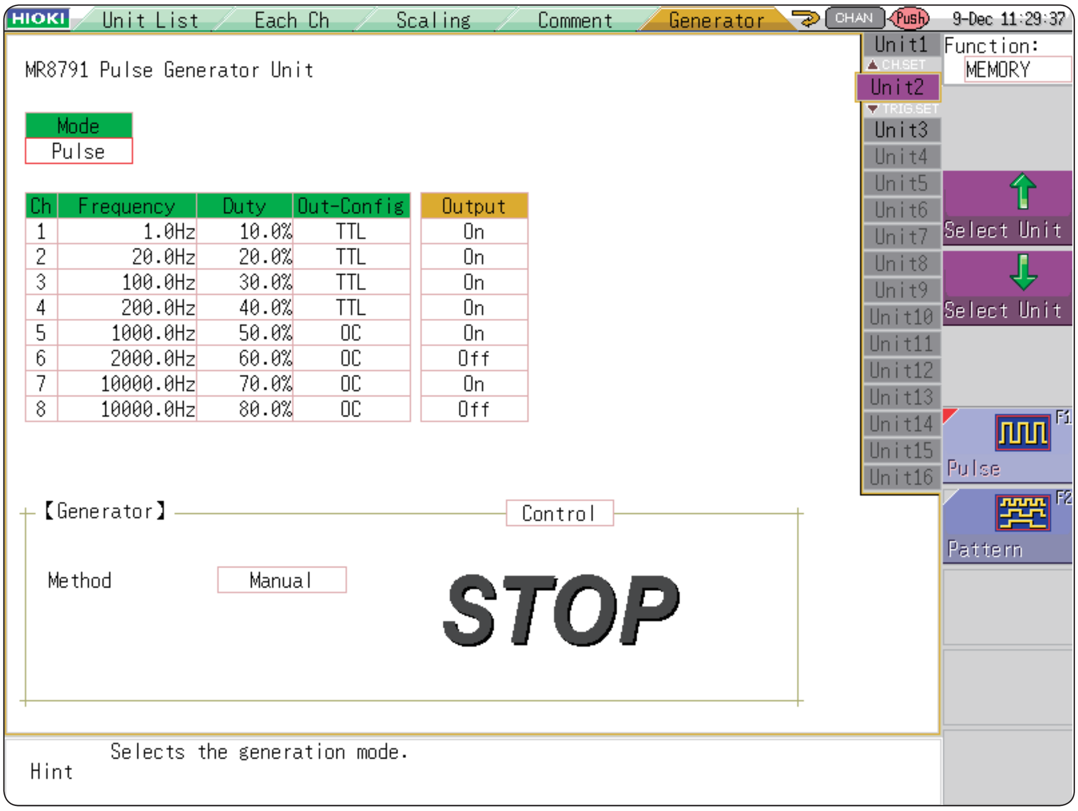
Manual	Restricts control of signal output to Signal Generation screen.
Sync.	Augments manual control with signal output in synchronization with the start and end of measurement. **START** key: Starts output when measurement starts. **STOP** key: Stops output when measurement stops.
Keys	Augments manual control by allowing signal output to be manipulated using the instrument’s keys. **START** key: Starts output. **STOP** key: Stops output. Manual Trigger key: Pauses output.

(For details, see the instruction manual of Models U8793, MR8790, and MR8791.)

8.10.12 Setting Model MR8791 Pulse Generator Unit

Channels installed with Model MR8791 cannot be measured.

Refer to: “To Open **[Each Ch]** and Make a Channel Selection” (p. 170)



Function: MEMORY

MR8791 Pulse Generator Unit

Mode: Pulse

Ch	Frequency	Duty	Out-Config	Output
1	1.0Hz	10.0%	TTL	On
2	20.0Hz	20.0%	TTL	On
3	100.0Hz	30.0%	TTL	On
4	200.0Hz	40.0%	TTL	On
5	1000.0Hz	50.0%	OC	On
6	2000.0Hz	60.0%	OC	Off
7	10000.0Hz	70.0%	OC	On
8	10000.0Hz	80.0%	OC	Off

【Generator】

Method: Manual

Hint: Selects the generation mode.

Mode Select the type of output.

Pulse	Pulse output (Default settings)
Pattern	Pattern output

Refer to the instruction manual of Models U8793, MR8790, and MR8791 regarding the detailed settings for pattern output.

- The pattern output can be selected only when used channel is set to 32 ch.
- When the used channels is changed, the pattern data will disappear.

Setting Channels to Use
Refer to: Refer to “8.4 Setting Channels to Use (Extending the Recording Length)” (p. 156)

Frequency Sets the frequency for pulse output.

0 Hz to 20000 Hz

Duty Sets the pulse duty.

0% to 100%

Out-Config Sets the output status.

TTL	TTL output
OC	Open collector output

Output Turns waveform output On/Off.

On	Outputs waveform.
Off	Does not output the waveform.

Control Sets the waveform output.

RUN	Starts output.
PAUSE	Pauses output. While output is paused, the output at the time [PAUSE] was pressed will be output.
STOP	Stops output.

Method Selects the control method for waveform output.

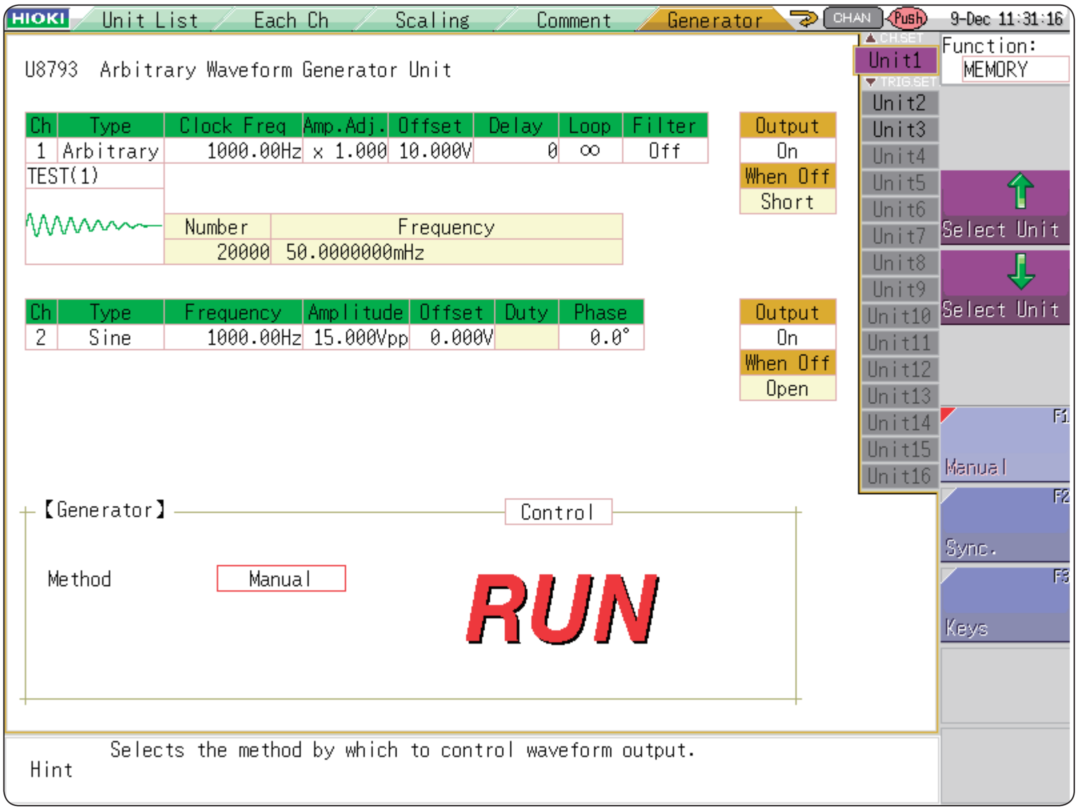
Manual	Restricts control of signaRefer to “8.4 Setting Channels to Use (Extending the Recording Length)” (p. 156)l output to Signal Generation screen.
Sync.	Augments manual control with signal output in synchronization with the start and end of measurement. **START** key: Starts output when measurement starts. **STOP** key: Stops output when measurement stops.
Keys	Augments manual control by allowing signal output to be manipulated using the instrument’s keys. **START** key: Starts output. **STOP** key: Stops output. Manual Trigger key: Pauses output.

(For details, see the instruction manual of Models U8793, MR8790, and MR8791.)

8.10.13 Setting Model U8793 Arbitrary Waveform Generator Unit

Channels installed with U8793 cannot be measured.

Refer to: “To Open **[Each Ch]** and Make a Channel Selection” (p. 170)



U8793 Arbitrary Waveform Generator Unit

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
1	Arbitrary	1000.00Hz	x 1.000	10.000V	0	∞	Off

TEST(1)

Number	Frequency
20000	50.0000000mHz

Output: On
When Off: Short

Ch	Type	Frequency	Amplitude	Offset	Duty	Phase
2	Sine	1000.00Hz	15.000Vpp	0.000V		0.0°

Output: On
When Off: Open

【Generator】 Control

Method: Manual

RUN

Hint: Selects the method by which to control waveform output.

Type Selects the waveform type.

DC	DC output (Default setting)
Sine	Sine wave output
Square	Rectangular wave output
Pulse	Pulse wave output
Triangle	Triangular wave output
Ramp-up	Ramp-up wave output
Ramp-down	Ramp-down wave output
Arbitrary	Outputs the created waveform
Program	Outputs the waveform set in the program

Refer the instruction manuals of Model U8793, MR8790, and MR8791 for the settings at the time of program selection.

Frequency Sets the frequency of output signal.

0 Hz to 100000 Hz

Amplitude

Sets the amplitude of output signal.
The output voltage with guaranteed accuracy is the sum of the amplitude and the offset, between -10 V and +15 V. If the sum of the amplitude and the offset is set outside the guaranteed accuracy range, parts of the waveform will be clamped to the upper limit, approximately +16 V and the lower limit, approximately -11 V.

0.000 V p-p to 20.000 V p-p

Offset

For DC output: Sets DC voltage.
For sine wave output: Sets the offset voltage.
The output voltage with guaranteed accuracy is the sum of the amplitude and the offset, between -10 V and +15 V. If the sum of the amplitude and the offset is set outside the guaranteed accuracy range, parts of the waveform will be clamped to the upper limit, approximately +16 V and the lower limit, approximately -11 V.

-10 V to +15 V

Phase

Sets the phase.

-360° to 360°

Duty

Sets the duty when selecting pulse wave.

0.1% to 99.9%

When Off

Sets the terminal status when the output is off.

Open	Opens the output terminals, separating them from internal circuits.
Short	Short-circuits the output terminals, separating them from internal circuits.

Output

Turns waveform output On/Off.

On	Outputs waveform.
Off	Does not output the waveform.

Control

Sets the waveform output.

RUN	Starts output. (Output indicator: Red)
PAUSE	Pauses output. While output is paused, the output at the time [PAUSE] was pressed will be output. (Output indicator: Red)
STOP	Stops output. (Output indicator: Off)

Method Selects the control method for waveform output.

Manual	Restricts control of signal output to Signal Generation screen.
Sync.	Augments manual control with signal output in synchronization with the start and end of measurement. **START** key: Starts output when measurement starts. **STOP** key: Stops output when measurement stops.
Keys	Augments manual control by allowing signal output to be manipulated using the instrument's keys. **START** key: Starts output. **STOP** key: Stops output. Manual Trigger key: Pauses output.

Settings when selecting arbitrary waveform

Data name Register/delete the data of the outputted waveform. Maximum eight waveforms can be registered.

Filter Filter the output waveform.

Off (Default setting) to 1 MHz

Clock Freq Set the clock frequency of the D/A converter that generates waveforms.
The period and frequency of the output waveform are displayed on the lower level.

Delay Set the delay for waveform generation. When the delay value is positive, the phase is progressive.

-250,000 data to 250,000 data (Default settings: 0)

Loop Set the repetition count for generating waveforms.

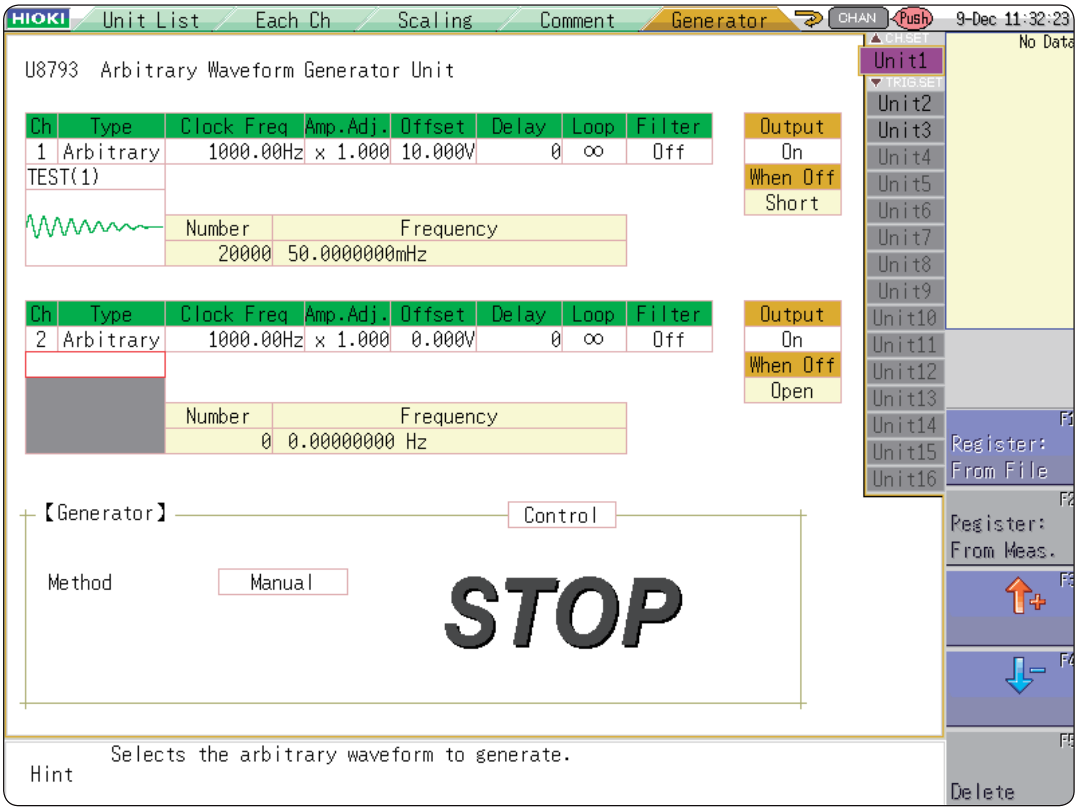
1 to 50,000, ∞ (Default setting: ∞)

Amp Adj Set the amplitude level for waveform output.

Offset Set the offset voltage for waveform.

8.11 Register the Waveform in the U8793 ArbitraryWaveform Generator Unit

ou can register waveform in the Model U8793. Registered waveforms can be output from the Model U8793.



U8793 Arbitrary Waveform Generator Unit

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
1	Arbitrary	1000.00Hz	x 1.000	10.000V	0	∞	Off

TEST(1)

Number	Frequency
20000	50.0000000mHz

Output
On
When Off
Short

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
2	Arbitrary	1000.00Hz	x 1.000	0.000V	0	∞	Off

Number	Frequency
0	0.00000000 Hz

Output
On
When Off
Open

【Generator】 Control

Method Manual

STOP

Hint Selects the arbitrary waveform to generate.

Procedure

To open the screen: press the **CHAN** key to open the Channel screen, and then select **[Generator]** sheet

1 **Set the type to random waveform.**

Move the cursor to **[Type]** on the settings screen, and select **[Arbitrary]** using the **F** keys.

2 **Register the waveform.**

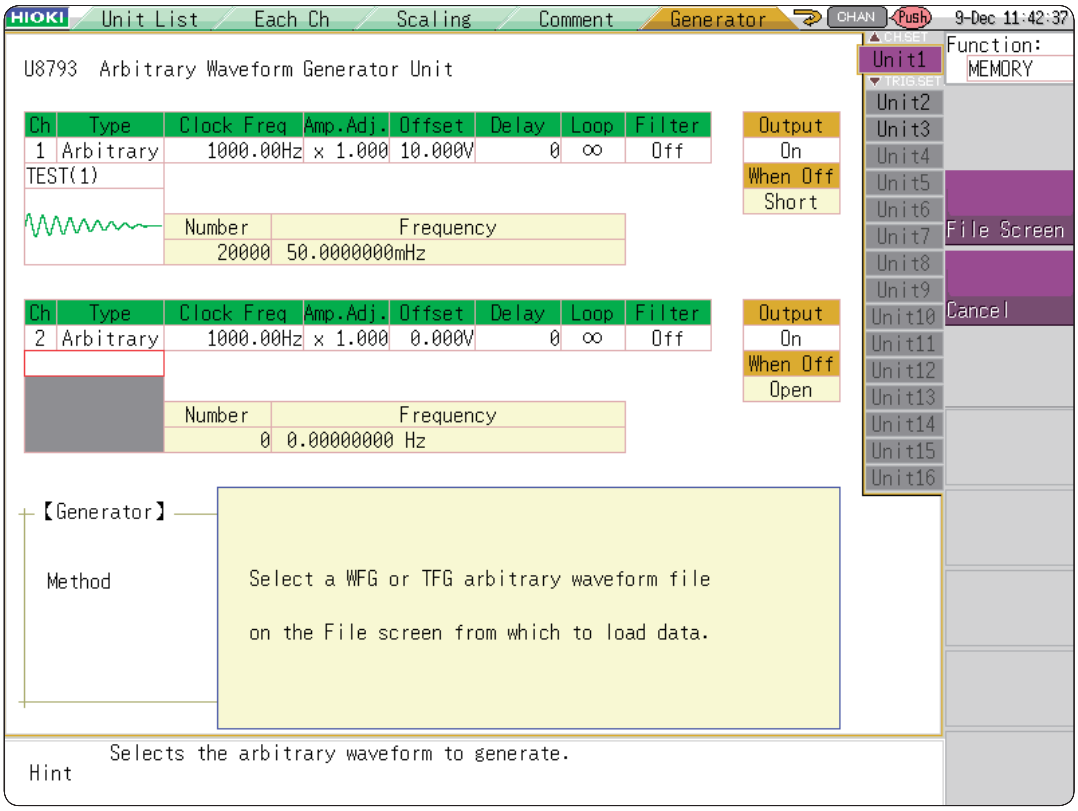
Move the cursor to the item listed below **[Arbitrary]** on the settings screen.

3 **Select a reading source of the waveform.**

Resister: From File	Registers from data saved in the media.
Register: From Meas.	Registers the data measured using memory function. You can also register after reading the MEM files from media to the instrument.
↑ or ↓	Select arbitrary waveform data registered in the Model U8793. (Use when selecting/deleting output waveforms.)
Delete	Deletes the data registered in the U8793 memory. If eight waveforms are already registered in the memory, delete any of them and then register.

Register From Files

1 **Select [Register..from file] using F keys**



Function: MEMORY

U8793 Arbitrary Waveform Generator Unit

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
1	Arbitrary	1000.00Hz	x 1.000	10.000V	0	∞	Off

TEST(1)

Number	Frequency
20000	50.0000000mHz

Output
On
When Off
Short

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
2	Arbitrary	1000.00Hz	x 1.000	0.000V	0	∞	Off

Number	Frequency
0	0.00000000 Hz

Output
On
When Off
Open

【Generator】

Method

Select a WFG or TFG arbitrary waveform file on the File screen from which to load data.

Hint Selects the arbitrary waveform to generate.

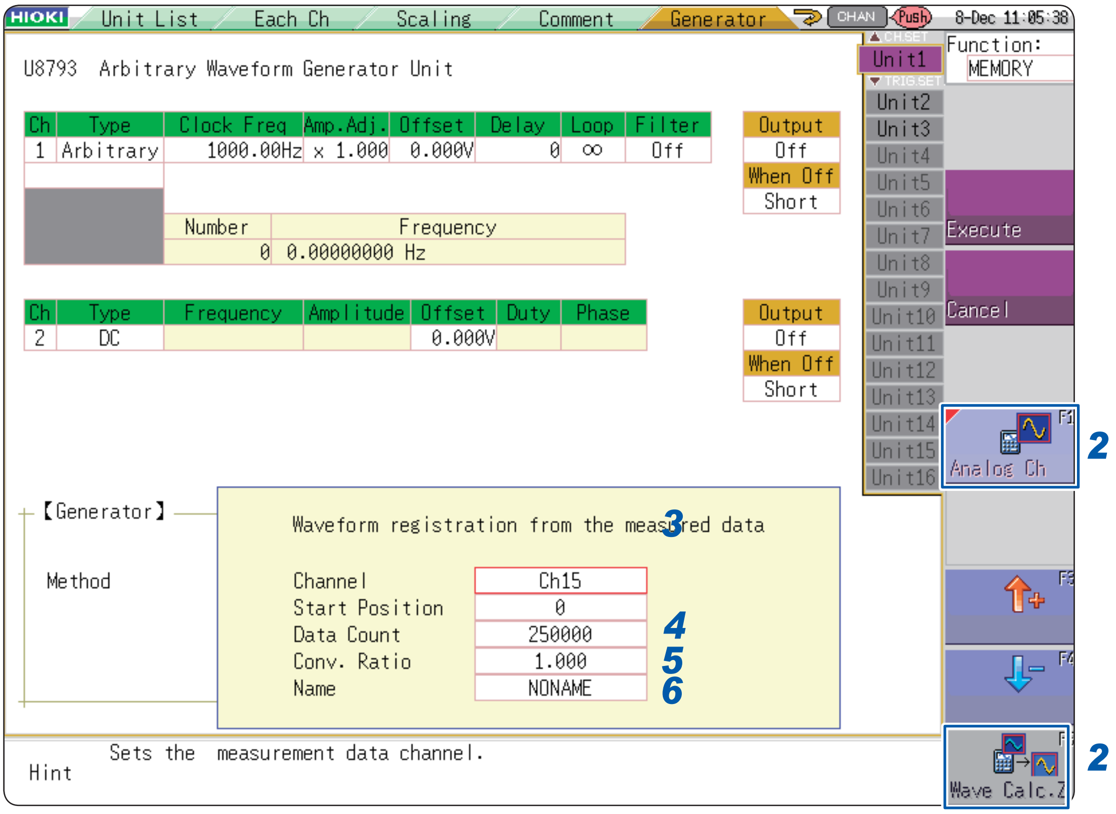
2 **Select [to File scrn] using the CH.SET key.**

Move to the file screen.

3 **Select arbitrary waveform file WFG or TFG on the file screen and then register.**

Register From Measured Data

1 **Select [Register..from measurement data] using F keys**



U8793 Arbitrary Waveform Generator Unit

Ch	Type	Clock Freq	Amp.Adj.	Offset	Delay	Loop	Filter
1	Arbitrary	1000.00Hz	x 1.000	0.000V	0	∞	Off

Number	Frequency
0	0.00000000 Hz

Ch	Type	Frequency	Amplitude	Offset	Duty	Phase
2	DC			0.000V		

Output: Off
When Off: Short

Output: Off
When Off: Short

Function: MEMORY

【Generator】

Method

Waveform registration from the measured data

Channel: Ch15
Start Position: 0
Data Count: 250000
Conv. Ratio: 1.000
Name: NONAME

Hint: Sets the measurement data channel.

2 **Select the waveform to be registered using F keys.**

Analog Ch	Registers the waveform of the measured analog channel.
Wave Calc. Z	Registers the waveforms with waveform calculation result.

3 **Select the waveform channels to register.**

Analog waveform

Ch1 to Ch32

Waveform calculations

Z1 to Z16

4 **Set the data count to be registered.**

Whole waveforms	Registers the whole wave.*
A-B waveforms	Registers the waveforms between AB cursors.*
Tenkey input	Randomly sets data lead position and data count in the numeric keypad input.

* Data count more than 250,000 (maximum registerable data count) cannot be registered.

5 **Set the conversion ratio.**

Amplify or attenuate a voltage value of the measured data to register it.

0.001 times to 100 times

6 **Enter a data name.**

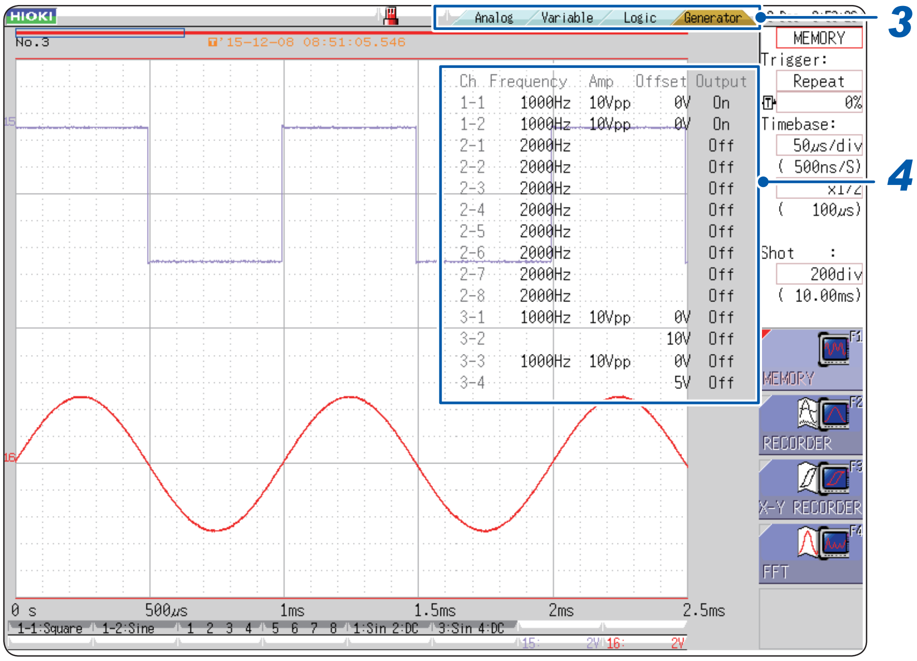
Register as an arbitrary waveform data in the U8793 memory.
Enter a **[Name]**.
When a data name is not entered, the data will be registered as **[NONAME]**.

8.12 Save the Waveforms Registered in the Model U8793 in the Media

You can save the arbitrary waveform data registered in U8793 in the media.
For saving methods, refer to “5.2.4 Save Waveform Output Data to the Media” (p. 98).

8.13 Setting Output Waveform Parameters

Parameters (frequency, amplitude, and offset) for the output waveform that was configured on the Generator screen (signal generation setting screen) can be changed on the Waveform screen.
The ability to configure and change these settings while outputting and measuring the resulting waveform provides a convenient way to measure a waveform while varying its parameters.



Ch	Frequency	Amp	Offset	Output
1-1	1000Hz	10Vpp	0V	On
1-2	1000Hz	10Vpp	0V	On
2-1	2000Hz			Off
2-2	2000Hz			Off
2-3	2000Hz			Off
2-4	2000Hz			Off
2-5	2000Hz			Off
2-6	2000Hz			Off
2-7	2000Hz			Off
2-8	2000Hz			Off
3-1	1000Hz	10Vpp	0V	Off
3-2			10V	Off
3-3	1000Hz	10Vpp	0V	Off
3-4			5V	Off

MEMORY
Trigger:
Repeat
0%
Timebase:
50µs/div
(500ns/S)
x1/2
(100µs)
Shot :
200div
(10.00ms)

1 **Display the Waveform screen (if viewing another screen, press DISP to display the Waveform screen).**

2 **Press CH.SET (to display the tabs).**

3 **Press CH.SET or select the [Generator] tab with the mouse.**

4 **Set the following parameters as desired.**

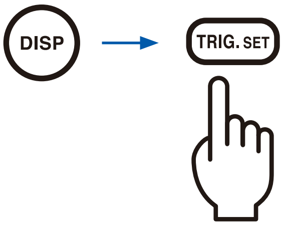
Frequency	Sets the frequency.
Amp	Sets the amplitude
Offset	Sets the offset.
Output	Turns output on or off.

(For details, see the instruction manual of Models U8793, MR8790, and MR8791.)

9 Trigger Settings

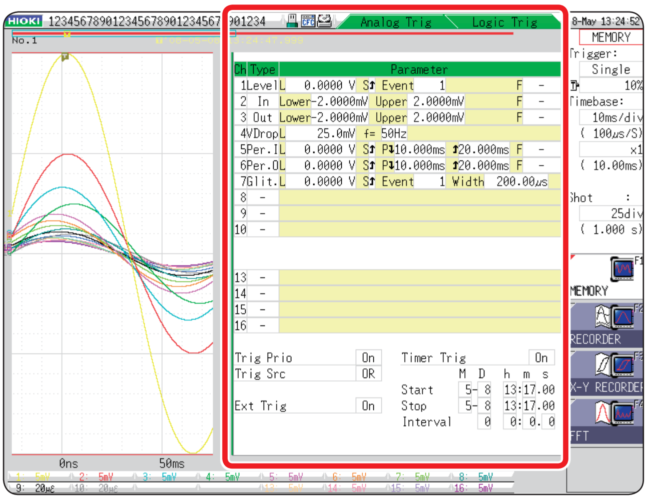
Triggering allows you to start and stop measurement using signals or conditions. When recording is started or stopped by a specific signal, we say the trigger is “applied” or “triggering occurs.”
You can configure triggers inform the Trigger settings window of the Waveform screen.
Triggers cannot be set with the X-Y Recorder function.

To Open the Trigger Settings Window



Pressing **TRIG.SET** repeatedly cycles through the following sheets.

[Analog Trig]
↓
[Logic Trig]
↓
No display



Ch	Type	Parameter
1	Level	L 0.0000 V S↑ Event 1 F -
2	In	Lower -2.0000mV Upper 2.0000mV F -
3	Out	Lower -2.0000mV Upper 2.0000mV F -
4	VDrop	L 25.0mV f= 50Hz
5	Per.I	L 0.0000 V S↑ P↓10.000ms ↑20.000ms F -
6	Per.O	L 0.0000 V S↑ P↓10.000ms ↑20.000ms F -
7	Glit.	L 0.0000 V S↑ Event 1 Width 200.00μs
8	-	
9	-	
10	-	
13	-	
14	-	
15	-	
16	-	

Trig Prio On
Trig Src OR
Ext Trig On

Timer Trig On

	M D	h m s
Start	5- 8	13:17.00
Stop	5- 8	13:17.00
Interval	0	0: 0. 0

If the trigger setting screen is hard to see due to waveform overlap, narrow the waveform display width to divide the waveform display screen and trigger settings screen.
Refer to “7.7.3 Switch the Waveform Display Width” (p. 142)

Operations available from the Trigger settings window

Trigger Settings

- Trigger mode settings (p. 197)
- Combined trigger logic (AND/OR) for multiple trigger sources (p. 214)
- Pre-trigger settings (p. 209)
- Trigger timing settings (p. 212)

Trigger Source Settings

Analog Trigger Settings (p. 198)

- Level Trigger
- Window trigger
- Period trigger
- Glitch trigger
- Voltage sag trigger

Timer Trigger Settings (p. 205)

External Trigger Settings (p. 208)

Manual Trigger Settings (p. 208)

Logic Trigger Settings (p. 203)

- Combined trigger logic settings
- Trigger filter settings
- Trigger pattern settings

Trigger Output (p. 351)

Search for trigger positions (p. 215)

9.1 Setting Workflow

Trigger Mode Settings	This setting controls whether the instrument continues to accept triggers after measuring.	(p. 197)
Trigger Type Settings	Make trigger source-related settings. • Analog trigger • Logic trigger • Timer Trigger • External Trigger • Manual trigger	 (p. 198) (p. 203) (p. 205) (p. 208) (p. 208)
MEM FFT Pre-trigger Settings	Set the amount to record before and after trigger points.	(p. 209)
REC Trigger Timing Settings	Set the start and stop timing for triggered recording.	(p. 212)
Set AND/OR Between Trigger Sources	Select the required AND/OR logical combination of analog, logic, external and timer triggers.	(p. 214)
Start Measurement	Press the **START** key to start measurement. (The key will light up in green.) (Operation may differ depending on the **START** key behavior settings (p. 315).) Data acquisition starts when trigger criteria are met. To stop measurement, press the **STOP** key. Press once: Recording will stop at the end of the specified recording length. Press twice: Recording stops when the key is pressed. Available settings for the respective items depend on the function.	

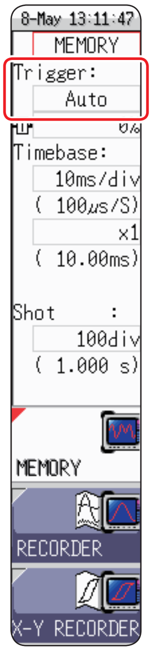
- Except for manual trigger, triggering is based on the logical combination of trigger sources (AND/OR). (p. 214)
- When triggering occurs, the TRIG OUT terminal for control of external devices carries an output signal. (p. 351)

9.2 Set the Trigger Mode

This setting controls whether the instrument continues to accept triggers after measuring.
If all trigger sources are disabled (Off, with no trigger setting), measurement starts immediately (free-running).

Procedure

Press the **DISP** key to open the Waveform screen.



8-May 13:11:47

MEMORY

Trigger: Auto

Timebase: 10ms/div (100μs/S)

x1 (10.00ms)

Shot : 100div (1.000 s)

1 **Move the cursor to [Trigger].**

2 **Select the trigger mode.**

Single	Only one trigger is recognized. After pressing the **START** key, once a trigger is applied, a waveform is recorded for the specified recording length, then measurement stops.
Repeat	Triggers are accepted continuously. When no trigger is applied, the instrument enters the Trigger Wait state. Press the **STOP** key to stop measurement. (See below)
Auto	MEM FFT Triggers are accepted continuously. If no trigger is applied within about one second, a waveform of the specified recording length is automatically recorded. Press the **STOP** key to stop measurement.

Available options depend on the function.

Trigger modes	Function	
	MEM FFT	REC
Single	O	O *(Default setting)*
Repeat	O	O
Auto	O *(Default setting)*	-

To Stop Measurement, press the **STOP** key.
Press once: Recording will stop at the end of the specified recording length.
Press twice: Recording stops when the key is pressed.

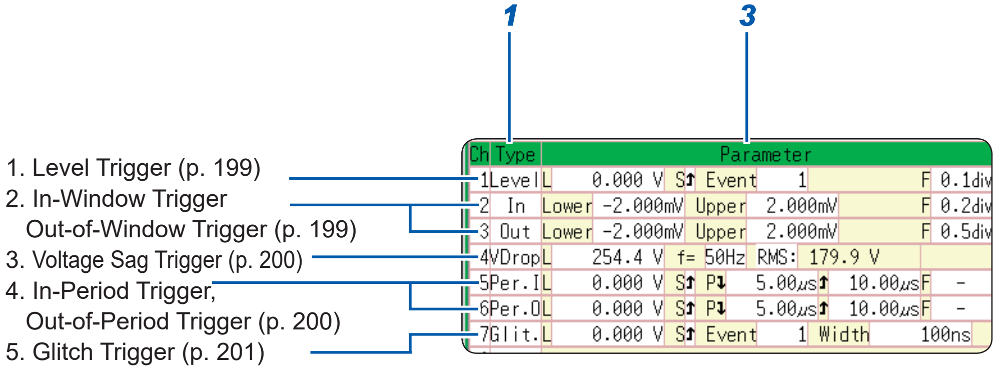
When the trigger mode is set to [Repeat]
During the processing interval (auto-save, auto-print, waveform display processing, numerical calculation) from the end of recording until next entering the Trigger Wait state, triggering will not be accepted.

9.3 Analog Signal Triggers

The process below explains how to set up the different types of analog triggers. These settings can be configured on the Trigger settings window (**[Analog Trg.]** sheet).

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window (**[Analog Trg.]** sheet).


1
3
1. Level Trigger (p. 199)
2. In-Window Trigger
Out-of-Window Trigger (p. 199)
3. Voltage Sag Trigger (p. 200)
4. In-Period Trigger,
Out-of-Period Trigger (p. 200)
5. Glitch Trigger (p. 201)

```
Ch Type                  Parameter
1Level L     0.000 V  S↑ Event     1                F 0.1div
2  In  Lower -2.000mV Upper  2.000mV                F 0.2div
3 Out  Lower -2.000mV Upper  2.000mV                F 0.5div
4VDrop L     254.4 V  f= 50Hz RMS: 179.9 V
5Per.I L     0.000 V  S↑ P↓    5.00μs↑  10.00μsF   -
6Per.O L     0.000 V  S↑ P↓    5.00μs↑  10.00μsF   -
7Glit. L     0.000 V  S↑ Event     1 Width     100ns
```

1 **Move the cursor to [Type] for the channel for which you want to change the settings.**

2 **Select the trigger type with the F keys.**

3 **Move the cursor to the parameter item with the CURSOR keys.**

4 **Select the parameter value with the F keys.**

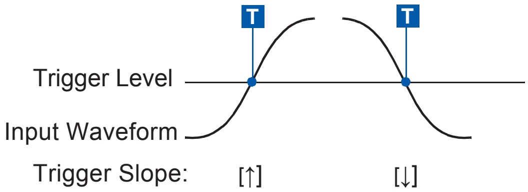
To copy the setting to another channel

The Trigger settings window ([Analog Trig] sheet) can be used to copy a setting.
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

Analog triggers cannot be set when the FFT function is used and **[Reference]** is set to **[From Memory]** on the [Status] sheet.

1. Level Trigger

A trigger is applied when the input signal crosses the specified trigger level (threshold voltage).

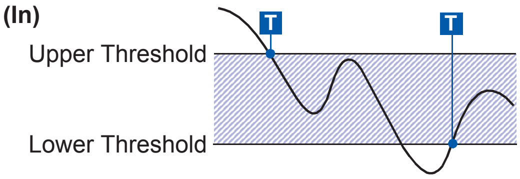


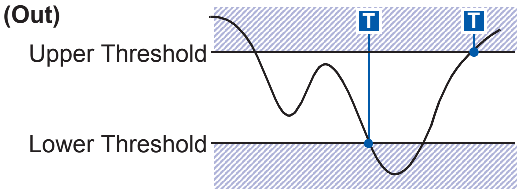
In this manual, **T** indicates a “trigger point,” the time at which a trigger is applied.

Type	Parameters	
[Level]	**[L] (Level)**	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the rising or falling edge. With the [ ] setting, triggering occurs in both directions. (↑, ↓, ↕)
	[Event]	The number of signal rising or falling edge events is counted and triggering occurs when the Event number set here is exceeded. (1 to 4000)
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT: OFF, 0.1 - 10 div REC: OFF, ON*) *: Filter width 10 ms.

2. In-Window Trigger, Out-of-Window Trigger

By setting upper and lower limit values for the trigger, a trigger will be applied when the input signal enters (In) or leaves (Out) this range.

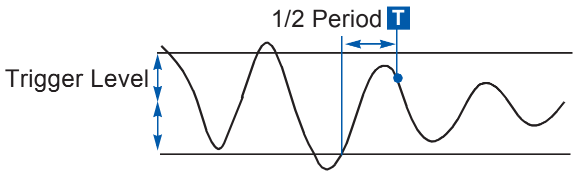




Type	Parameters	
[In] **or** **[Out]**	**[Lower]**	Set the lower limit value. (The setting can be made in 1/50 increments.)
	[Upper]	Set the upper limit value. (The setting can be made in 1/50 increments.)
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT : Off, 0.1 - 10 div, REC: Off, On*) *: Filter width 10 ms

3. Voltage Sag Trigger (MEM FFT Only)

Triggering occurs when the voltage peak drops below a preset level for more than half a cycle. The allowable timebase is 20 μs to 50 ms/div.

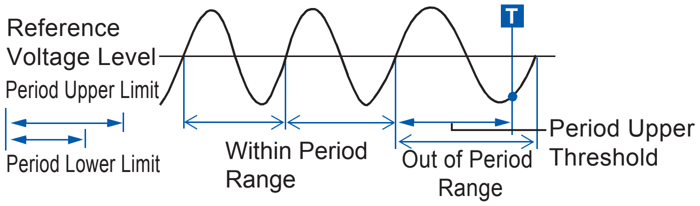


Type	Parameters	
[VDrop]	**[L] (Level)**	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[f=] (Frequency)	Select 50 or 60 Hz.
	RMS: (actual value)	The target actual value. Changes when the level setting changes.

4. In-Period Trigger, Out-of-Period Trigger

The rising edge and falling edge cycle of the reference voltage is measured, and triggering occurs when the cycle enters the preset range (In) or leaves the preset range (Out).

Refer to “About period range settings”, “About the trigger point of the Out-of-Period trigger” (p. 202).



About the Trigger Point

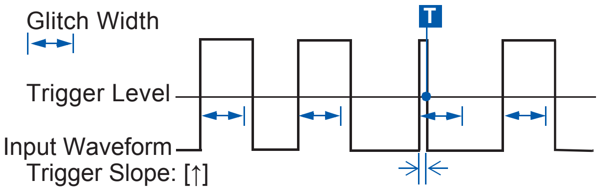
The trigger point occurs one sample after the criterion is met.

Type	Parameters	
[Per.I] **or** **[Per.O]**	**[L] (Level)**	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the rising or falling edge. (↑, ↓)
	[P↓] (Period lower limit)*1	Available settings are 0 and more than 5 times the sampling frequency. This cannot be set to be higher than the Period upper limit setting. (When the setting is 0, the lower limit is disregarded, and triggering occurs only on the upper limit.)
	[↑] (Period upper limit)*1	The setting range extends to 20,000 times the sampling frequency. This cannot be set to be lower than the Period lower limit setting.
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT: Off, 0.1 - 10 div, REC: Off, On*) *: Filter width 10 ms.

*1 Changes when the timebase changes.

5. Glitch Trigger (MEM FFT Only)

Triggering occurs when the input signal crosses the trigger level (threshold voltage) if its pulse width is shorter than the specified width.

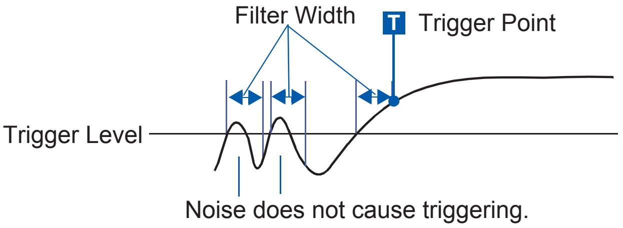


Type	Parameters	
[Glit.]	**[L] (Level)**	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the rising or falling edge. (↑, ↓)
	[Event]	The number of signal rising or falling edge events is counted and triggering occurs when the Event number set here is exceeded. (1 to 4000)
	[Width]	Sets the pulse width (time) that is used to determine a glitch. Triggering occurs when the width is lower than this value. (The available setting range depends on the sampling frequency. Lower limit: sampling frequency × 2, upper limit: sampling frequency × 4000)

When Using Noisy Signals for Triggering

Method 1: Enable the trigger filter

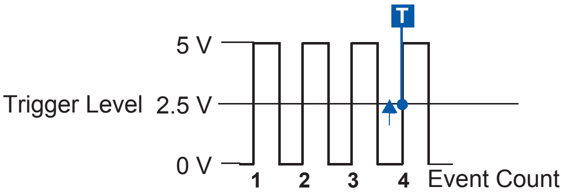
By setting the filter width to prevent triggering on noise, triggering occurs only when the trigger criteria continue to be met for at least the specified width (interval).



Method 2: Setting an Event Count

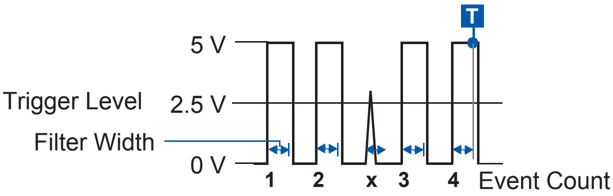
If triggering occurs too frequently, an event count can be specified so that a trigger is accepted only after the specified number of trigger events has occurred.

Example: When the event count is set to **[4]** (Slope: ↑)



To Suppress the Effects of Noise

Noise near the trigger level can erroneously increment the event count. Use the trigger filter to avoid this problem.



About period range settings

The period range settings for period triggering depend on the sampling period (sampling rate). (Changing the timebase also changes the period setting range.)
The [Sampling Rate] setting can be verified on the Status screen - **[Status]** sheet.
The upper threshold of the period range cannot be set below the lower threshold, and vice-versa.
Lower threshold: can be set either to zero, or to at least five times the sampling period.
Upper threshold: can be set to no more than 20,000 times the sampling period.

To apply a trigger when the frequency increases (shorter period) above the upper threshold

Set the period trigger type to **[Per.I]** and the lower threshold to **[0]**. The lower threshold will be ignored and triggering will occur when the frequency exceeds the upper threshold.

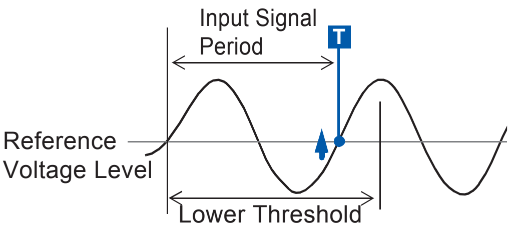
To apply a trigger when the frequency decreases (longer period) below the upper threshold

Set the period trigger type to **[Per.O]** and the lower threshold to **[0]**. The lower threshold will be ignored and triggering will occur when the frequency drops below the upper threshold.

About the trigger point of the Out-of-Period trigger

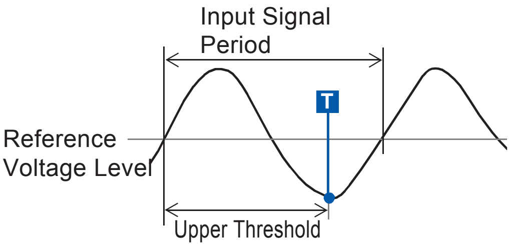
Triggering occurs when the period of sequential crossings of the specified reference voltage exceeds the period range.
The point at which triggering occurs depends on the specified period range and the period of the measured signal.

When the input signal period is shorter than the specified lower threshold (Trigger Slope: ↑)



Triggering occurs when the rising edge (↑ trigger slope) of the input signal crosses the reference voltage level, before reaching the lower period threshold.

When the input signal period is longer than the specified upper threshold (Trigger Slope: ↑)



Triggering occurs when the upper threshold period is reached, before the rising edge (↑ trigger slope) of the input signal crosses the reference voltage level.

The trigger point is determined by the upper threshold of the period range.

9.4 Logic Signal Triggers (Logic Trigger)

Follow the steps for below to configure logic triggers. These settings can be configured from the **[Logic Trig]** sheet of the Trigger settings window.

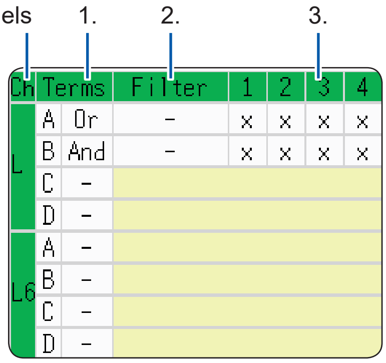
- Input signals on logic channels serve as the trigger source.
  Triggering occurs when the specified trigger pattern and logical probe combination criteria (AND/OR) are met.
- The trigger detection method can be selected according to whether a trigger is applied or not when the criteria are already met at the start of measurement.
- By using the trigger filter, triggering can be limited so as to occur only when trigger criteria are met for at least the specified filter width.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window (**[Logic Trg.]** sheet).

1 **Move the cursor to the channel for which you want to change the settings.**

2 **Use the F keys to select the settings.**



Ch		Terms	Filter	1	2	3	4
L	A	Or	-	×	×	×	×
	B	And	-	×	×	×	×
	C	-					
	D	-					
L6	A	-					
	B	-					
	C	-					
	D	-					

1. Trigger

Sets the trigger probe logic (AND/OR).

Off	Logic triggering is disabled. *(Default setting)*
OR	Triggering occurs when the input signal logic matches any setting in the trigger pattern.
AND	Triggering occurs only when the input signal logic matches all settings in the trigger pattern.

2. Filter

Sets the filter width (trigger filter) for triggering. (If necessary)
Suppresses triggering from noise. (p. 201)

MEM	Off	Trigger filtering disabled. *(Default setting)*
	0.1 to 10	Trigger filtering enabled. The filter width is set as a number of divisions.
REC	Off	Trigger filtering disabled. *(Default setting)*
	On	Trigger filtering enabled. Filter width 10 ms (5 ms when the sampling rate is 100 ns/S)

3. Trigger Pattern Set the logic trigger pattern.

X	Ignore signal. *(Default setting)*
0	Trigger at LOW signal level.
1	Trigger at HIGH signal level

To copy the setting to another channel

The Trigger settings window ([Logic Trig] sheet) can be used to copy the settings between channels.

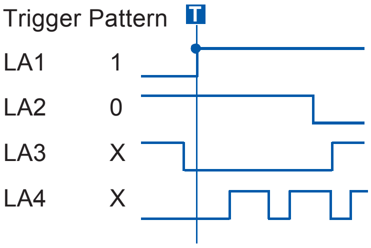
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

Setting Examples

Example 1: Trigger when the input signal matches any of the following criteria

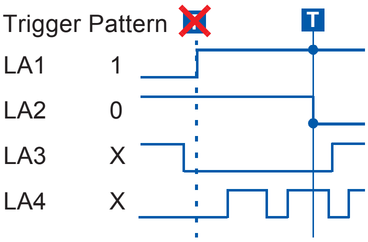
LA1: HIGH level
LA2: LOW level
Trigger: OR
LA [1, 2, 3, 4]: [1 0 X X]

Triggering occurs when the LA1 or LA2 trigger criteria are met.



Example 2: Triggering occurs when the input signal matches both of the following criteria

LA1: HIGH level
LA2: LOW level
Trigger: AND
LA [1, 2, 3, 4]: [1 0 X X]



- If the criteria are already met when **START** is pressed (AND: all trigger patterns are met, OR: one trigger pattern is met), triggering will not occur.
  Triggering only occurs if the conditions are changed and then the criteria are met again.
- Triggers for standard logic channels (LA, LB, LC, LD, LE, LF, LG, and LH) are enabled regardless of the logic waveform display or module type.

9.5 Trigger by Timer or Time Interval (Timer Trigger)

This trigger allows you to record at fixed times.

- Triggering occurs at the specified interval from the specified Start time until the Stop time.
- Before setting up a Timer Trigger, verify that the clock is set to the correct time. If not, set the clock on the System screen - **[Init]** sheet. (p. 52)

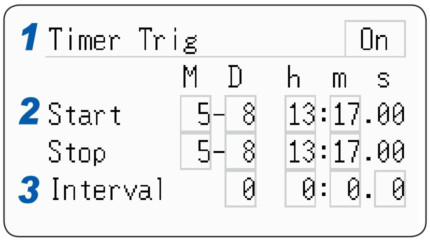
Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window.

1 **Enable or disable the timer trigger.**

Move the cursor to the [Timer Trig] item.

Off	Timer triggering disabled.
On	Timer triggering enabled.



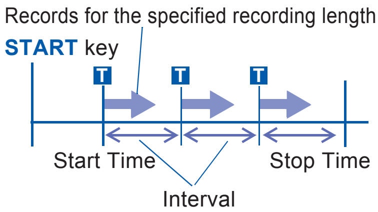
```
1 Timer Trig          On
            M  D   h  m  s
2 Start     5- 8  13:17.00
  Stop      5- 8  13:17.00
3 Interval     0   0: 0. 0
```

2 **(When [On] is selected)**

Set Start and Stop times.

Move the cursor to **[M]**, **[D]**, **[h]** and **[m]** to set recording Start and Stop times.
Set the date and time.

To set to the current date and time, select **[Present Time]**.

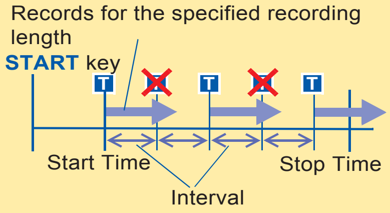


3 **(To apply a trigger through the specified interval, from Start to Stop)**

Set the Interval.

Move to cursor to **[D]**, **[h]**, **[m]** and **[s]** of **[Interval]**.
Set the recording interval.

When the specified interval is shorter than the specified recording length:



When the recording length exceeds the specified interval

The next trigger is not applied until the data for the specified recording length has been acquired.

4 **Press the START key.**

Measurement starts and recording will start at the specified Start time.

To stop recording early, press the **STOP** key.

When the recording length exceeds the stop time

Recording time depends on the operating function.
(p. 206)

When the interval is set to zero

If the **[Repeat]** trigger mode is selected, or the REC or MEM functions are used, recording is repeated from Start to Stop times.

The timer trigger time and the time at which the trigger is actually fired may differ by up to 3 sample times.

About start and stop times

- Start and Stop times should be set as times elapsed since the **START** key was pressed.
- When the trigger mode is **[Single]** and the timer trigger is **[On]**, only one timer trigger specified as the Start trigger will be recognized. Interval and Stop time triggers are ignored.

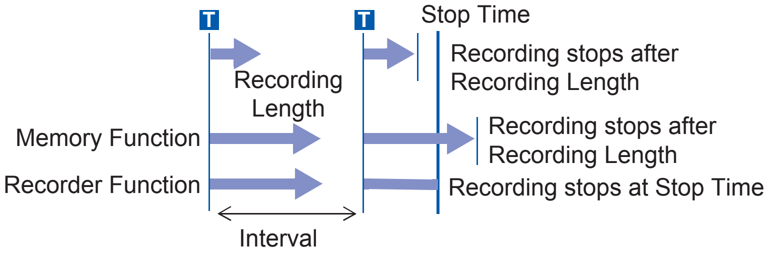
To record an interval with specified Start and Stop times

Set the trigger mode to **[Repeat]**, and set all other trigger sources **[Off]**.
However, triggering is disabled during processing (auto-save, auto-print, waveform display processing and calculation) from the end of recording to the next Trigger Wait state, so depending on measurement settings, recording may not occur within the specified interval.

About Stop Time and Recording Length

The stop time is function-dependent.
Memory function: Measurement data is acquired for the specified recording length, then recording stops.
Recorder function: Measurement data continues to be acquired until the specified Stop time.

Relationship Between Last Recording Length and Stop Time


T
T
Stop Time
Recording stops after Recording Length
Recording Length
Memory Function
Recording stops after Recording Length
Recorder Function
Recording stops at Stop Time
Interval

When a trigger is applied from a trigger source other than a timer trigger

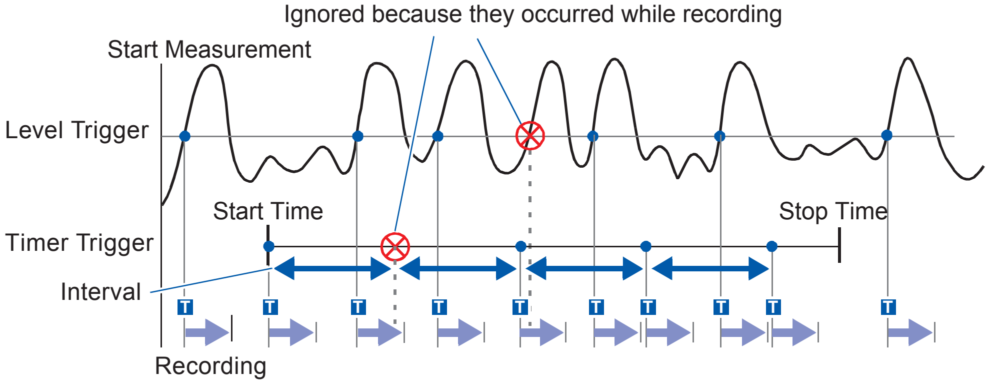
Trigger sources set to **[On]** are all enabled.
However, trigger timing depends on the trigger source settings.

- **When trigger criteria are combined with OR (Trigger Source: OR)**
  Depending on the other trigger sources, triggering can occur before the specified trigger Start time, after the specified Stop time, or outside of the specified Interval.

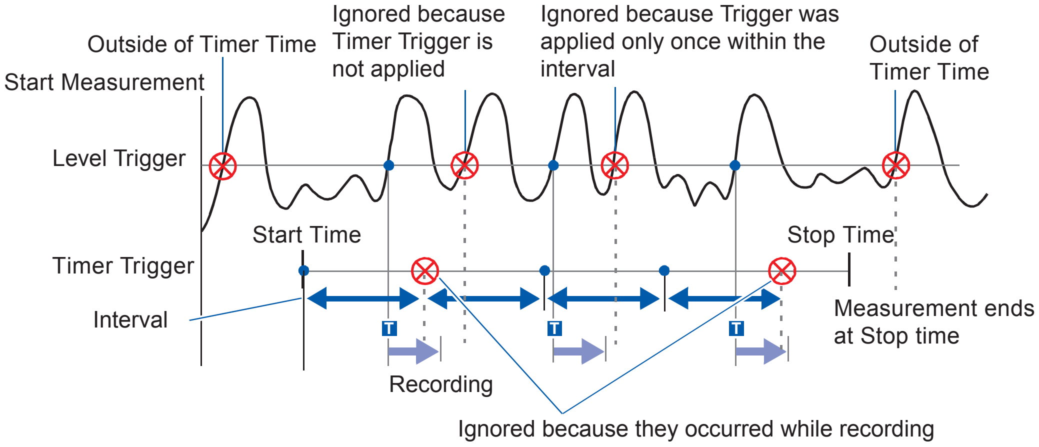
- **When trigger criteria are combined with AND (Trigger Source: AND)**
  Triggering occurs between the specified Start and Stop times when criteria for all trigger sources set within the specified interval are satisfied.
  If the interval is set to zero, triggering occurs when criteria for all trigger sources set between specified Start and Stop times are satisfied.

Example: measuring when both timer trigger and level triggers (Slope: ↑) are enabled.

When trigger criteria are combined with OR (Trigger Source: OR)



When trigger criteria are combined with AND (Trigger Source: AND)


Outside of Timer Time
Start Measurement
Ignored because Timer Trigger is not applied
Ignored because Trigger was applied only once within the interval
Outside of Timer Time
Level Trigger
Start Time
Stop Time
Timer Trigger
Interval
Measurement ends at Stop time
T
Recording
Ignored because they occurred while recording

9.6 Apply an External Trigger (External Trigger)

An external signal applied to the External Control terminal can serve as a trigger source.
It can also be used to drive synchronized parallel triggering of multiple instruments.

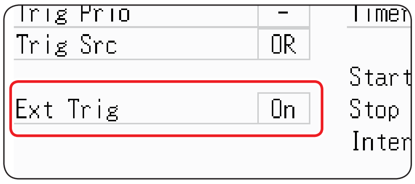
Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window.

1 **Enable external triggering.**

Move the cursor to [Ext Trig].

Off	External triggering disabled. *(Default setting)*
On	External triggering enabled.

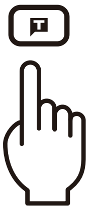


Trig Prio –
Trig Src OR
Ext Trig On

2 **Apply the input signal to the external trigger (EXT.TRIG) terminal.**

Refer to “17.2.5 External Trigger Terminal (EXT.TRIG)” (p. 352).

9.7 Trigger Manually (Manual Trigger)



Triggers can be applied manually by pressing the **Manual Trigger** key.
Manual triggering takes priority over all other trigger sources, regardless of settings.

To stop recording, press the **STOP** key.

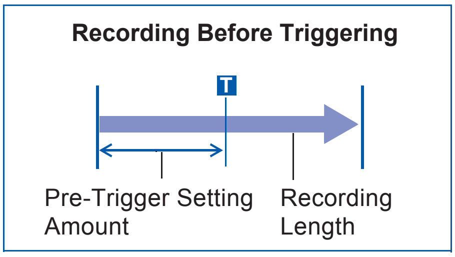
Press the key once	Recording is carried out for one recording length and then stops.
Press the key twice	Recording stops when the key is pressed.

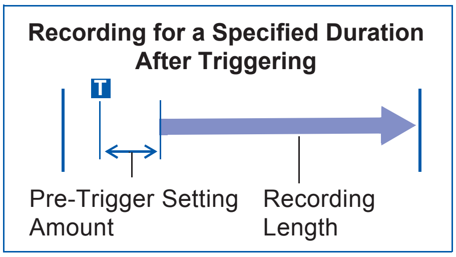
As for other trigger types, triggering does not occur during pre-trigger standby. Set the trigger priority function to **[On]**.
Refer to “9.8.2 Set Trigger Acceptance (Trigger Priority)” (p. 211).

9.8 Pre-trigger Settings

MEM FFT

This applies to the Memory and FFT functions only.
By setting a portion (number of divisions or percentage) of the recording length to occur before triggering, the waveform can be recorded before as well as after the trigger point.
You can also set the duration of a waveform to be recorded after a trigger point.




Recording for a Specified Duration After Triggering
T
Pre-Trigger Setting Amount
Recording Length

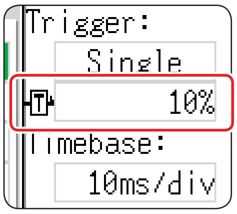
- When all trigger sources (analog, timer trigger, etc.) are disabled (Off), pre-trigger settings are ignored.
- Pre-triggers cannot be set by div with the FFT function.

9.8.1 Set the Trigger Start Point (Pre-trigger)

Set the position of the trigger point relative to the specified recording length.
There are two setting methods. (Setting by percent and setting by div)

Procedure

Press the **DISP** key to open the Waveform screen.



Trigger:
Single
T 10%
Timebase:
10ms/div

1 **Select the unit to use when setting the pre-trigger.**

Move the cursor to **[Pre-trigger].**

%	Set the pre-trigger in %. *(Default setting)*
div	Set the pre-trigger in number of divs. For external sampling, set by number of samples.

2 **Enter the numerical value.**

(When [%] is selected)

With the recording start point as 0% and the recording end point as 100%, set the % for the trigger point.

-95%, 100%, 95%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 10%, 5%, 2%, 0%

(When [div] is selected)

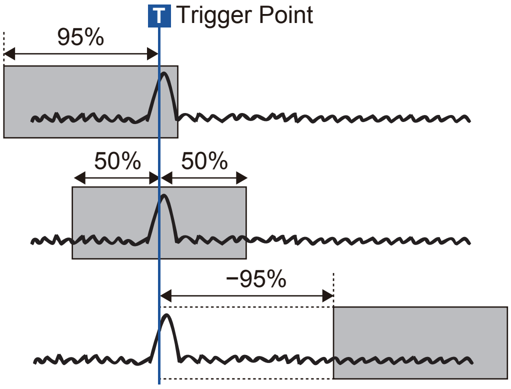
With the recording start point as 0 div and the recording end point as the set recording length, set the number of div for the trigger point.

-Recording length (div) to +Recording length (div)

About pre-triggering and the recording period (recording length)

Pre-trigger setting examples

95%	95% of the recording length is recorded before the trigger point
50%	50% of the recording length is recorded before and 50% after the trigger point
−95%	The recording length is recorded after 95% of the recording length after the trigger point



Trigger events during the specified pre-trigger recording period are ignored. To enable recognition of such triggers, set Trigger Priority to **[On]**.
Refer to “9.8.2 Set Trigger Acceptance (Trigger Priority)” (p. 211).

Difference between **[Pre-Trigger wait]** and **[Trigger wait]**

When measurement is started, the specified pre-trigger length is recorded. This period is indicated as **[Pre-Trigger wait]**.
After the specified pre-trigger length has been recorded, **[Trigger wait]** continues until a trigger occurs.
Refer to “Measurement and Internal Operations” (p. 75).

9.8.2 Set Trigger Acceptance (Trigger Priority) MEM

This applies to the Memory function only.
You can set whether triggers are recognized (accepted) if trigger criteria are met during the Pre-trigger wait period.

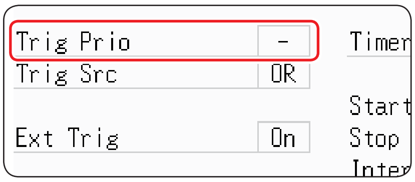
- When pre-triggering is enabled, trigger events are normally ignored for a certain period after measurement starts (while recording the specified pre-trigger period).
- **[Pre-Trigger wait]** is displayed on the screen.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window.

Move the cursor to **[Trig Prio].**

Off	Trigger events are not recognized (accepted) during **[Pre-Trigger wait]**. *(Default setting)*
On	Trigger events are recognized (accepted) during **[Pre-Trigger wait]**.

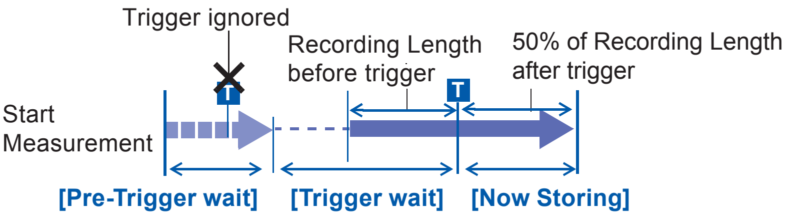


Trig Prio -
Trig Src OR
Ext Trig On

When trigger criteria are met during [Pre-Trigger wait]

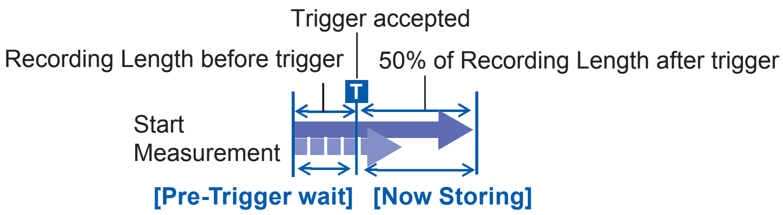
Example: When the pre-trigger period is set to 50%

Trigger Priority: [Off]



(After 50% of the Recording Length is recorded internally, the **[Trigger wait]** state begins)

Trigger Priority: [On]


Trigger accepted
Recording Length before trigger
50% of Recording Length after trigger
T
Start Measurement
[Pre-Trigger wait]
[Now Storing]

(A trigger event occurs while 50% of the Recording Length is being recorded internally)

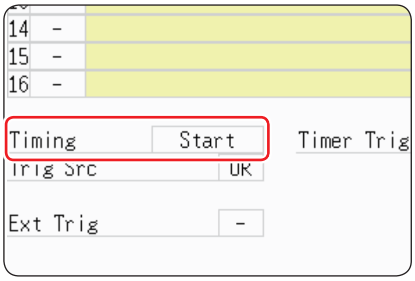
When a trigger event occurs during pre-trigger recording, the data actually recorded may be shorter than the specified recording length. (In this case, the pre-trigger recording length is shortened. The recording length after the trigger event is the specified recording length minus the specified pre-trigger period.)

9.9 Set Trigger Timing REC

This applies to the Recorder function only.
Use the below procedure to control waveform recording operation when a trigger event occurs.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window.



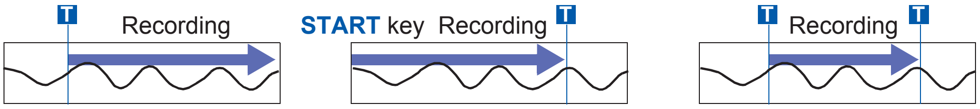
14 -
15 -
16 -
Timing Start
Timer Trig
Trig Src OR
Ext Trig -

Move the cursor to **[Timing].**

Start	Start recording when a trigger event occurs, and stop after the specified recording length. *(Default setting)*
Stop	Start recording when the **START** key is pressed, and stop when a trigger event occurs.
Start & Stop	Record the interval from one trigger event until the next trigger event.

About trigger timing

The selected trigger mode determines how recording stops.



	[Start]	[Stop]	[Start & Stop]
Recording Starts	Recording starts when a trigger event occurs	Recording starts when you press the **START** key	Recording starts when a Start trigger event occurs
Recording Stops	↓	↓	↓
[Single] trigger mode	Recording stops after data has been acquired for the specified recording length	Recording stops when a trigger event occurs	Recording stops when a Stop trigger event occurs

If no trigger event occurs before the specified recording length elapses
[Stop] or **[Start & Stop]**: Recording stops after data has been acquired for the specified recording length

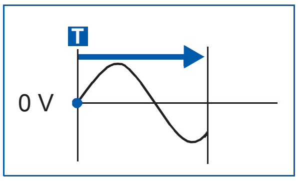
	[Start]	[Stop]	[Start & Stop]
[Repeat] trigger mode	The Trigger Wait state begins after data has been acquired for the specified recording length When another trigger event occurs, data is again acquired for the specified recording length, then Trigger Wait resumes (repeats)	When a trigger event occurs, recording stops and then starts again (repeats)	When a trigger event occurs, recording stops and the instrument re-enters the Trigger Wait state. When another trigger event occurs, recording continues until the next trigger occurs (repeats)

If no trigger event occurs before the specified recording length elapses
[Stop]: After data is acquired for the specified recording length, recording restarts. This repeats until a trigger event occurs.
[Start & Stop]: The Trigger Wait state begins after data has been acquired for the specified recording length (Start Trigger)

Example: When the trigger type is Level Trigger, Level = 0.000 V, and Slope = ↑(rising)

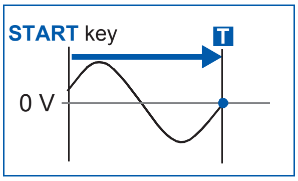
Setting of [Timing]

[Start]



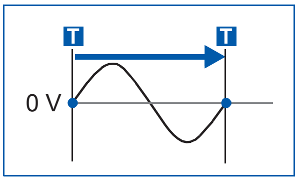
Records for specified recording length

[Stop]



Press **START** key to record. Records until a trigger occurs.

[Start & Stop]



Recording starts when a Start trigger event occurs. Records until a Stop trigger occurs.

The above sequences repeat when the trigger mode is **[Repeat]**.

9.10 Combined Trigger Logic (AND/OR) for Multiple Trigger Sources

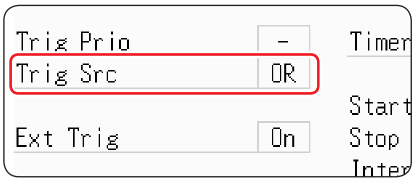
Analog, logic, external and timer trigger criteria can be combined using AND/OR logic to define complex trigger criteria.

Procedure

Press the **DISP** key to open the Waveform screen, and then press the **TRIG.SET** key to open the trigger settings window.

Move the cursor to **[Trig Src].**

OR	Triggering occurs when any one of the specified trigger source criteria is met. *(Default setting)*
AND	Triggering occurs only when all of the specified trigger source criteria are met.



Trig Prio –

Trig Src OR

Ext Trig On

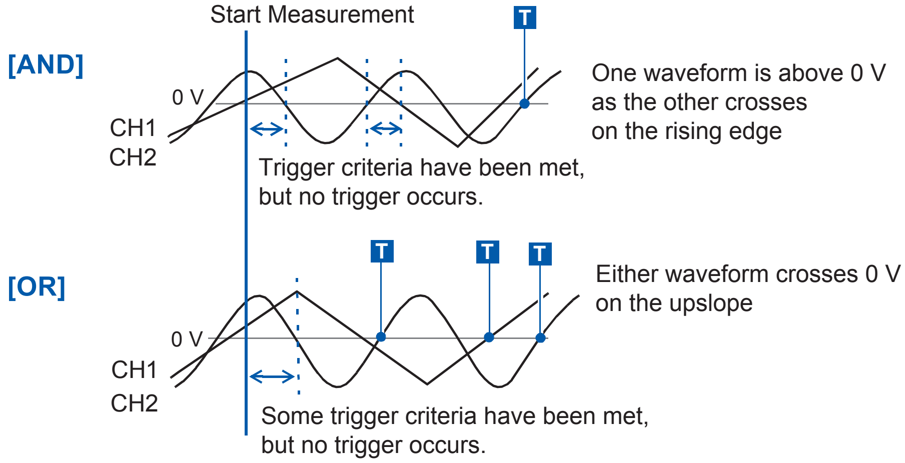
(When using the Memory Function)

When the trigger combination logic is set to [AND]

If trigger criteria are already met when you press the **START** key, no triggering occurs. Triggering occurs only after all trigger sources have ceased to meet the criteria then meet the criteria again.

Setting Example:
To apply a trigger when the upslope (↑) of the waveform crosses zero volts
Triggering occurs as follows when combined using AND and OR.

Channel	Trigger	Trigger Level	Slope	Filter
CH1, CH2	Level	0.00 V	↑	Off



Start Measurement

[AND]

One waveform is above 0 V as the other crosses on the rising edge

Trigger criteria have been met, but no trigger occurs.

[OR]

Either waveform crosses 0 V on the upslope

Some trigger criteria have been met, but no trigger occurs.

If both **[Start]** and **[Stop]** trigger timing criteria are combined, the simultaneous trigger sources are combined with a logical AND.

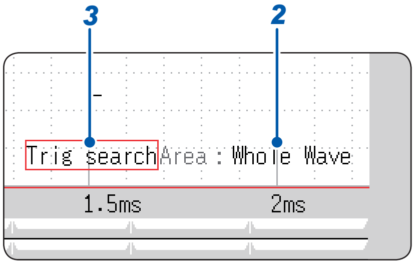
9.11 Use Trigger Settings to Search Measurement Data

MEM

Trigger settings can be used to search measurement data.
Locations that match the set trigger criteria in the measurement data are searched for and displayed sequentially.
Using the same method as setting triggers, it is possible to search for criteria different from the triggers set at the time of measurement.
Example 1: The measurement trigger criteria was trigger level of 0 V but the data search condition is level 100 V.
Example 2: After measurement with a free run without a trigger, search for locations that exceed 100 V (level 100 V).

Procedure

Press the **DISP** key to open the Waveform screen.
→ Press the **TRIG.SET** key → Trigger settings window (**[Analog Trig]** or **[Logic Trig]** sheet)



Trig search Area : Whole Wave
1.5ms 2ms

1 **After measurement is finished, set the search criteria.**

The setting method is the same as described in “9.3 Analog Signal Triggers” (p. 198) and “9.4 Logic Signal Triggers (Logic Trigger)” (p. 203).

2 **Specify the search range.**

Move the cursor to the **[Area]** item.

Whole Wave	Search all measured data. *(Default setting)*
A-B Wave	Search in the range between AB cursor.

(When using memory division)

All Display Blocks	Searched all data in all displayed blocks. *(Default setting)*
A-B Display Blocks	When setting the AB cursors on the displayed blocks, searches the range between the A and B cursors on the displayed blocks.
All Blocks	Searched all data in all whole blocks.
A-B All Blocks	When setting the AB cursors for the all blocks, searches the range between the A and B cursors for all blocks.

- When selecting AB range and only the A cursor is shown on the screen, search will be performed on the data after A cursor.
- The search range for **[All Blocks]** will be defined as the start block up to the number of blocks to be measured.

3 **Execute search.**

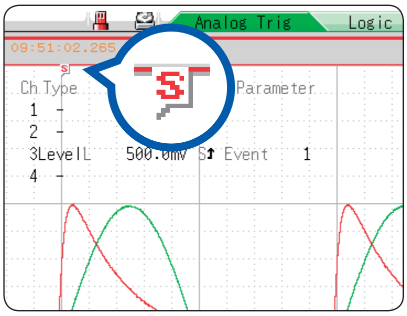
Move the cursor to **[Trig search].**

Execute search	Start the search from the beginning of the measurement data.
Search next	Searches for the next search condition after the most recent search position.
Move A cursor	Move A cursor to the search position.
Move B cursor	Move B cursor to the search position.
Clear	Clear the search position.

[Search] and **[Search next]** can be performed using the **Manual Trigger** key as well.

Search results

Locations that match the criteria are displayed in the center of the screen and marked with an S.



```
Ch Type              Parameter
 1  -
 2  -
 3LevelL    500.0mV S↑ Event    1
 4  -
```

When no matches are found, a message stating that **[No Matches Were Found]** is displayed.

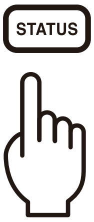
- Pre-triggers, trigger priorities, external triggers and timer triggers cannot be used as search conditions.
- The trigger position and search results may not match.

10 Numerical Calculation Functions

MEM

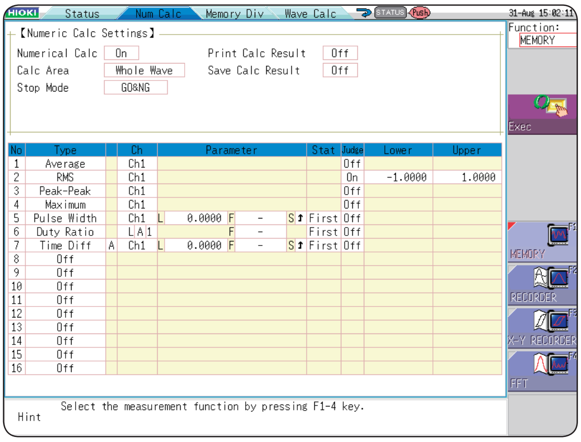
Numerical calculations can only be used with the Memory function.
Results calculated from the acquired waveform are displayed as numerical values on the Waveform screen. These calculation results can be judged for evaluation. Numerical calculation settings are made on the Status screen - **[Num Calc]** sheet.

To Open the [Num Calc] Sheet



Press this key repeatedly to display the various sheets.

[Status]
↓
[Num Calc]



【Numeric Calc Settings】

Numerical Calc: On
Calc Area: Whole Wave
Stop Mode: GO&NG
Print Calc Result: Off
Save Calc Result: Off

No	Type		Ch	Parameter	Stat	Judge	Lower	Upper
1	Average		Ch1			Off		
2	RMS		Ch1			On	-1.0000	1.0000
3	Peak-Peak		Ch1			Off		
4	Maximum		Ch1			Off		
5	Pulse Width		Ch1	L 0.0000 F - S ↑	First	Off		
6	Duty Ratio		L A 1	F -	First	Off		
7	Time Diff	A	Ch1	L 0.0000 F - S ↑	First	Off		
8	Off							
9	Off							
10	Off							
11	Off							
12	Off							
13	Off							
14	Off							
15	Off							
16	Off							

Hint: Select the measurement function by pressing F1-4 key.

Operations Available From the [Num Calc] Sheet

Numerical Calculations

- Average
- RMS (Root-Mean-Square) value
- Peak-to-Peak Value (P-P Value)
- Maximum Value
- Time to Maximum Value
- Minimum Value
- Time to Minimum Value
- Period
- Frequency
- Rise Time
- Fall Time
- Standard Deviation
- Area
- X-Y Area
- Time to Level
- Level at Time
- Pulse Width
- Duty Ratio (%)
- Pulse Count
- Four Arithmetic Operations
- Time difference calculation
- Phase diffemce calculation
- High level calculation
- Low level calculation
  (24 types in total)
- Specified calculation between AB cursors

Waveform calculations can be limited to data within the range specified by the AB cursors.

Calculation operator details: “10.6 Numerical Calculation Type and Description” (p. 230)

Numerical Calculation Judgment (p. 224)

The result of a numerical calculation can be compared to a preset reference range, for GO/NG (Pass/Fail) evaluation.

There are 24 types of numerical calculations in total, 16 of which can be performed simultaneously. When the Scaling function is used, numerical calculation is performed on scaled values.

Save/Print Numerical Calculation Results

- Auto-save numerical calculation results
- Save specified existing numerical calculation result

Refer to “10.4 Save Numerical Calculation Results” (p. 227).

- Auto-print
- Arbitrary printing

Refer to “10.5 Print Numerical Calculation Results” (p. 229).

10.1 Numerical Calculation Workflow

There are two different ways of performing calculation.

• **Calculate While Measurent:**	Settings for numerical calculation must be chosen before starting measurement.
• **Apply Calculations to Existing Data:**	Calculation can be performed on waveform data after measurement is completed, and for data saved on storage media.

Calculate While Measuring

Choose Calculation Settings ↓	**Choose calculation settings on the [Num Calc] sheet** When judging based on calculation results To automatically print or save calculation results: Choose printing and saving settings before starting measurement. • Save calculation results automatically • Print calculation results automatically	(p. 220) (p. 224) (p. 227) (p. 229)
Start Measurement ↓		
Acquire Data ↓	**The instrument acquires data when the trigger criteria are met.** (If triggering is not enabled, the instrument acquires data when you press the **START** key.)	
Calculate ↓	**[Measuring] will appear on the screen's status bar.** Calculations are performed sequentially from No. 1 to No. 16. (To interrupt calculation, press the **STOP** key to abort)	
Display Calculation Results ↓	**Results will be displayed on the Waveform screen.**	(p. 223)
(Calculation Judgment) ↓	**(only if judgment is enabled)**	
(Print or Save) ↓	**(if auto-printing or auto-saving are set to [On].)** Calculation results are automatically printed or saved.	
Stop Measurement		

Apply Calculations to Existing Data

(Load Data)	**(To load measurement data from storage media for calculation)**	(p. 99)
Choose Calculation Settings	**Choose calculation settings on the [Num Calc] sheet** When judging based on calculation results	(p. 220) (p. 224)
Execute Calculation	**Select [Exec] to execute calculations.** (To interrupt calculation, press the **STOP** key)	
Display Calculation Results	**Results will be displayed on the Waveform screen.**	(p. 223)
(Calculation Judgment)	**(only if judgment is enabled)**	
(Print or Save)	**Print (When Model U8350 Printer Unit is installed) or save calculation results as needed.** • Print: **PRINT** key • Save: **SAVE** key **When [Print Calc Result] (p. 229) or [Save Calc Result] (p. 227) is set to [On], results are automatically printed or saved.**	

To specify a waveform range for calculation

Before executing the calculation, specify the calculation range using the AB cursors (div or Trace cursors) on the Waveform screen. Set the calculation range on the **[Num Calc]** sheet to **[A-B Wave]**.

- Range cursors cannot be used to specify the range.
- When one cursor is used, the calculation range is from the cursor to the end of the data.

Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131) or “10.2 Numerical Value Calculation Settings” (p. 220).

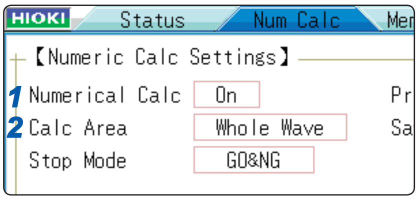
10.2 Numerical Value Calculation Settings

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Num Calc]** sheet.

1 **Enable the Numerical Calculation function.**

Move the cursor to **[Numerical Calc]**.
Select **[On]**.



【Numeric Calc Settings】
1 Numerical Calc On
2 Calc Area Whole Wave
Stop Mode GO&NG

2 **Specify the waveform calculation range.**

Move the cursor to **[Calc Area]**.

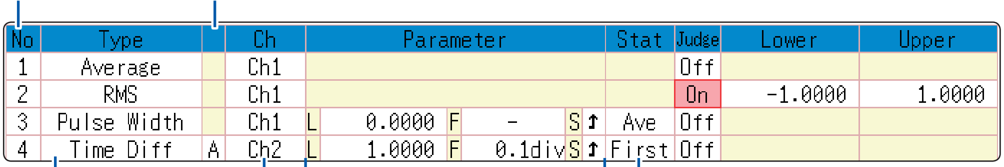
Whole Wave	Applies calculations to the whole waveform. *(Default setting)*
A-B Wave	Applies calculations to the data between AB cursors.
After Trigger	Applies calculations to the waveform after trigger.

Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131).

When selecting **[A-B Wave]**, specify the calculation range using the AB cursors on the Waveform screen.
If no measurement data has been acquired by the instrument, first measure once so that the range can be specified for calculations to be applied to subsequent measurements.

3 **Choose calculation settings.**

Calculation No. **(5)**Phenomenon



No	Type		Ch	Parameter	Stat	Judge	Lower	Upper
1	Average		Ch1			Off		
2	RMS		Ch1			On	-1.0000	1.0000
3	Pulse Width		Ch1	L 0.0000 F - S ↑	Ave	Off		
4	Time Diff	A	Ch2	L 1.0000 F 0.1div S ↑	First	Off		

(1) Calculation Type **(2)**Channel for Calculation **(3)**Parameters* **(4)**Statistical calculation

*: Setting choices depend on the calculation type.

(1) Select the calculation type.

Move the cursor to the number of the calculation type for which you want to choose settings. Select the calculation type.
(When **[List]** is selected, a list of calculation types appears. To clear the display, press the **TRIG.SET** key.)

Select [Judge] if you require judgment of calculation results. (p. 224)

Off	No calculation. *(Default setting)*	Area	Area enclosed by zero position and signal waveform
Average	Average value of waveform data	X-Y Area	Area of X-Y composite waveform
Rms	RMS value of waveform data	Time to Lev*	Time from trigger to specified level
Peak-Peak	Peak-to-peak value of waveform data	Lev-time	Measurement value at a specified time point after triggering
Maximum	Maximum value of waveform data		
Max-Time	Time from trigger to maximum value	Pulse Width*	Pulse width of waveform data
Minimum	Minimum value of waveform data	Duty Ratio*	Duty of waveform data
Min-Time	Time from trigger to minimum value	Pulses*	Pulse count of waveform data
Period*	Period of signal waveform	Calculation	Four arithmetic operations on numerical calculation results
Frequency*	Frequency of signal waveform	Time Diff*	Time difference between phenomenon A and B.
RiseTime	Rise time of waveform data	Phase Diff*	Time difference between phenomenon A and B displayed as a phase differnce.
FallTime	Fall time of waveform data	High Level	High level value for waveform data
Std Dev	Standard deviation of waveform data	Low Level	Low level value for waveform data

*: This setting can also be made for logic channels

(2) Select the channel for calculations.

Move the cursor to the item for the calculation target, and select the channel.

(Logic channels can also be selected for Time to Level, Pulse Width, Duty Cycle, and Pulse Count.)

(3) Set parameters.

Settings may not be necessary for some types of calculation. When calculating time differences and phase differnce, choose settings for both A and B channels.

Move the cursor to the parameter items, and make the appropriate parameter settings.

Refer to "Parameter Table" (p. 222).

Refer to "8.1.3 Alphanumeric Input" (p. 149).

When printing or saving calculation results during measurement

Settings must be made before the measurement.

Refer to "10.4 Save Numerical Calculation Results" (p. 227) or "10.5 Print Numerical Calculation Results" (p. 229).

When printing or saving existing data

Use PRINT key or SAVE key.

Refer to "5.2.3 Save Data Selectively (SAVE Key)" (p. 94) or "6.3 Manual Printing With the PRINT Key (Selective Printing)" (p. 118).

(4) Set the statistical calculation.

Move the cursor to the **[Stat]** column.

First	Calculate at the first condition of the measurement data.
Average	Acquire the average value of the calculation results in the measurement data.
Max	Acquire the maximum value from the calculation results in the measurement data.
Min	Acquire the minimum value from the calculation results in the measurement data.

(5) When time difference calculation or phase differnce calculation has been selected, set Ch (channel) and parameters for A and B.

4 Execute the calculations. (When judging calculations (p. 224))

Apply Calculations to Existing Data

Select **[Exec]**.

When calculating automatically after measurement

Press the **START** key to start measurement.

To copy calculation settings to another calculation

Use the **[Num Calc]** sheet.

Refer to "8.9 Copy Settings to Other Channels (Copy Function)" (p. 169).

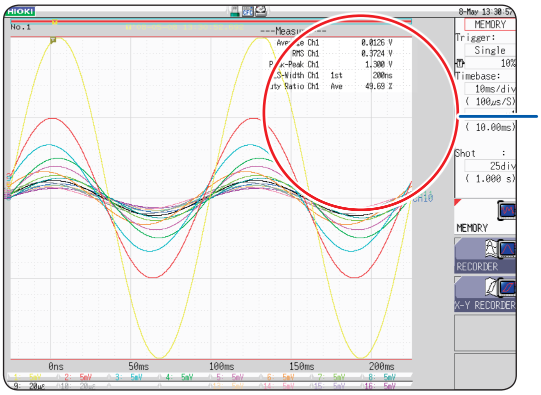
Parameter Table

Calculation type	Parameter	Parameter description
Period Frequency Pulse Width Pulses Duty Ratio* Time Diff Phase Diff * Level and Filter only	L (Level)	Calculation is based on the interval (time) when the level is crossed.
	F (Filter)	Only when the measurement signal has crossed the level and has not crossed the level again within the specified filter width, it is taken as a valid event. This is useful to exclude level crossing events caused by noise.
	S (Slope [↑, ↓])	Calculation is based on the interval (time) when the level is crossed. Depending on this setting, either crossing on the upward slope (↑) or downward slope (↓) is used for calculation.
Risetime Falltime	P (%)	Determines which section of the waveform between the upper and lower limits is used for risetime (or falltime) calculation. The range is narrowed from the upper and lower limit values by the percentage set here.
Time to Lev	L (Level)	Calculates the time specified level is crossed.
	F (Filter)	Only when the measurement signal has crossed the level and has not crossed the level again within the specified filter width, it is taken as a valid event. This is useful to exclude level crossing events caused by noise.
	S (Slope [↑, ↓])	Determines whether the time is calculated until the signal crosses the specified level on the upward slope or on the downward slope.
Lev-time	Time or Measure (Calculation results)	Specifies the time for calculating the measurement value, using the trigger position as zero. To use numerical calculation results, specify the numerical calculation number. The range specified by AB cursors is not available.
Calculation	Numerical Calculation No.	Sets the numerical calculation number.
	+, - , ×, ÷	Sets operators for the four basic arithmetic operations.

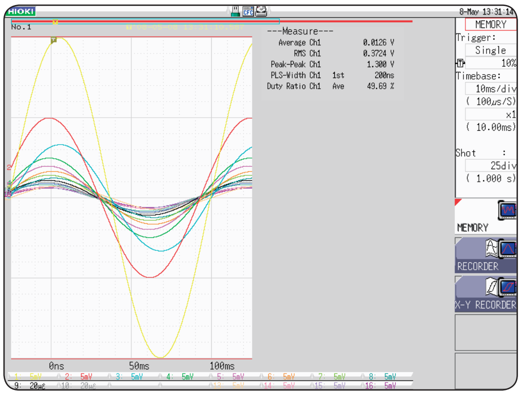
- Depending on the signal waveform, calculation values for the Period, Frequency, Risetime, and Falltime parameters may not be displayed.
- When Scaling is enabled, the waveform data is scaled before numerical calculation. The units for parameter values are derived from the units set for the Scaling function.
  About Scaling, refer to: “8.5 Convert Input Values (Scaling Function)” (p. 157).

10.2.1 Display Numerical Calculation Results

Numerical calculation results are displayed on the Waveform screen



If the display is hard to view because the numerical values and waveforms overlap,



```
---Measure---
   Average Ch1           0.0126 V
       RMS Ch1           0.3724 V
 Peak-Peak Ch1            1.300 V
 PLS-Width Ch1   1st      200ns
Duty Ratio Ch1   Ave      49.69 %
```

Press the **DISP** key.
Numerical values and waveforms will be displayed separately.
Refer to “7.7.3 Switch the Waveform Display Width” (p. 142).

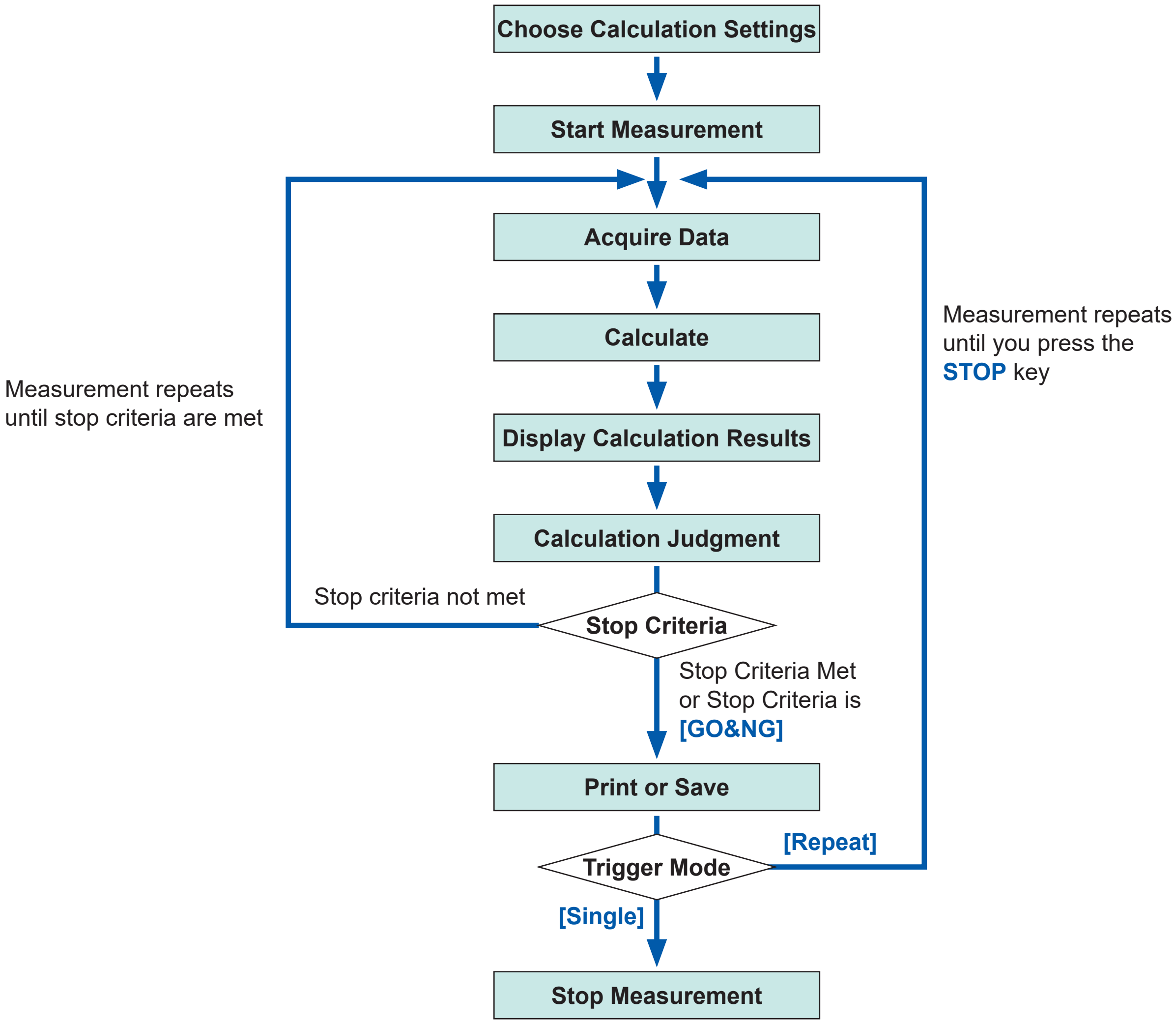
To save calculation results after measuring

Set the [Select at save] item to **[Yes]**. When you press the **SAVE** key after measurement, you can select the content to be saved.
(Select **[Calc Result]**.)
Refer to “5.2.3 Save Data Selectively (SAVE Key)” (p. 94).

10.3 Calculation Result Judgment

Set the judgment criteria (upper and lower threshold values) to use when judging numerical calculation results.
Judgment criteria can be set for every numerical calculation.

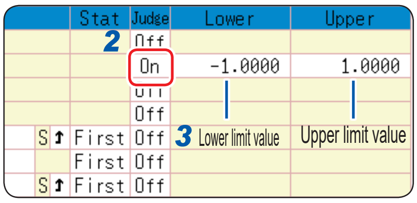
Waveform acquisition processing depends on the trigger mode setting (Single or Repeat) and the criteria specified to stop measuring upon judgment (**[GO]**, **[NG]**, or **[GO&NG]**).

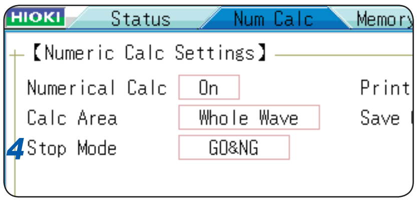

Choose Calculation Settings
Start Measurement
Acquire Data
Calculate
Display Calculation Results
Calculation Judgment
Stop Criteria
Stop criteria not met
Stop Criteria Met or Stop Criteria is [GO&NG]
Print or Save
Trigger Mode
[Repeat]
[Single]
Stop Measurement
Measurement repeats until stop criteria are met
Measurement repeats until you press the STOP key

Automatic saving and automatic printing will not be carried out before termination conditions are fulfilled at the end of calculation evaluation.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Num Calc]** sheet.





【Numeric Calc Settings】

Numerical Calc On

Calc Area Whole Wave

Stop Mode GO&NG

1 **Choose calculation settings. (p. 220)**

2 **Enable the judgment function.**

Move the cursor to **[Judge]** for the Calculation on which you want to use judgement, and select **[On]**.

Off	Judgment not carried out.
On	Result will be NG (Fail) if judgment range is exceeded. Any channel for which the result was NG will be shown in red.

3 **Specify the judgment thresholds.**

Move the cursor to **[Lower]** and **[Upper]**.

Select an entry method and enter threshold values.

Input range: −9.9999E+29 to +9.9999E+29

Refer to “8.1.3 Alphanumeric Input” (p. 149).

4 **Select the Stop Criteria upon judgment.**

Move the cursor to **[Stop Mode]**.

GO	Continue to the next process when within the threshold range (Pass judgment)
NG	Continue to the next process when outside of the threshold range (Fail judgment)
GO&NG	Continue to the next process regardless of judgment result.

↓

Execute the calculation.

When judging the existing data

Select **[Exec]**.

When using automatic judgment after measurement

Press the **START** key to start measurement.

About upper and lower threshold

The upper threshold cannot be set below the lower threshold, and vice-versa.

About executing the calculation

Processing depends on the Trigger Mode setting.

If calculating while acquiring waveforms, measurement will be repeated until the Stop Criteria are met. (p. 224)

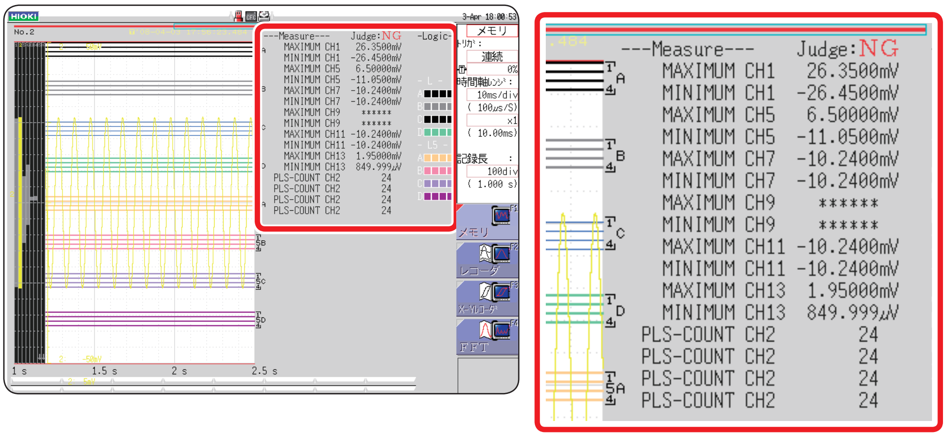
To record all calculation results

Set the Stop Mode item to **[GO&NG]**.

10.3.1 Display Judgment Results and Signal Output

Numerical calculation judgment results are displayed on the Waveform screen.

Within the judgment threshold range: GO judgment
Out of the judgment threshold range: NG judgment (displayed in red)



```
---Measure---       Judge:NG
  MAXIMUM CH1    26.3500mV
  MINIMUM CH1   -26.4500mV
  MAXIMUM CH5    6.50000mV
  MINIMUM CH5   -11.0500mV
  MAXIMUM CH7   -10.2400mV
  MINIMUM CH7   -10.2400mV
  MAXIMUM CH9     ******
  MINIMUM CH9     ******
  MAXIMUM CH11  -10.2400mV
  MINIMUM CH11  -10.2400mV
  MAXIMUM CH13   1.95000mV
  MINIMUM CH13   849.999μV
PLS-COUNT CH2         24
PLS-COUNT CH2         24
PLS-COUNT CH2         24
PLS-COUNT CH2         24
```

When printing, judgment results for each parameter will also be printed.

When the judgment result is GO

- The GO signal is output at the GO/EXT.OUT.1 external I/O terminal.

When the judgment result is NG

- The NG signal is output at the NG/EXT.OUT.2 external I/O terminal. The NG judgment is asserted when any channel is judged as NG.
- When the beeper is enabled, a beep sounds when a result is out of the threshold range.

10.4 Save Numerical Calculation Results

By choosing measurement settings before starting measurement you can calaculate then automatically save the results during measurement.

⚠CAUTION

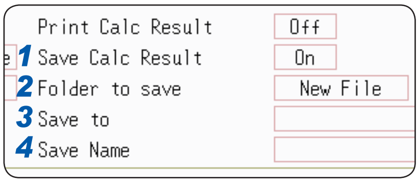
When using auto-save during measurement, do not remove the storage media specified as the save destination until the measurement operation is completely finished. Doing so may damage data on the storage media.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Num Calc]** sheet.

1 **Enable the saving of numerical calculation results.**

Move the cursor to **[Save Calc Result]**.
Select **[On]**. (default setting: Off)



Print Calc Result Off
1 Save Calc Result On
2 Folder to save New File
3 Save to
4 Save Name

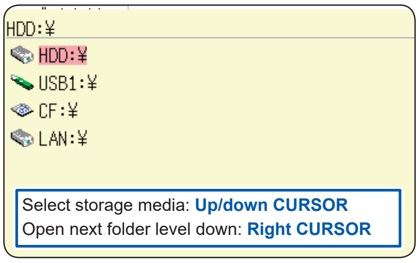
2 **Select the file creation method.**

Move the cursor to **[Folder to save]**.

New File	Creates a new file for each measurement.
Existing File	Adds calculation results to one file. When there is more than one file, results are added to the file with the smallest sequential number and saved.

3 **Set the save destination.**

Move the cursor to **[Save To]**.
Select **[Edit]**.
The Browse folders dialog box appears (at bottom right).



HDD:¥
HDD:¥
USB1:¥
CF:¥
LAN:¥

Select storage media: **Up/down CURSOR**
Open next folder level down: **Right CURSOR**

Move the cursor to the save target media.
Select **[Confirm]** to confirm the selection.

To create a new folder to use as the save target, select **[New Folder]**. When **[LAN]** is set as the save destination, [New Folder] is ignored and a folder named with the current date will be created.

HDD	Automatically save the waveform data on the built-in drive. (When Model U8330 SSD Unit is installed)
CF	Automatically save the waveform data on a CF card.
USB	Automatically save the waveform data on a USB memory stick.
LAN	Automatically save the waveform data on a PC connected via LAN. Model 9333 LAN Communicator required.

4 **Enter a filename (if you want to use a different name).**

Move the cursor to **[Save Name]**.
Enter a file name. (default setting: MEAS)
Refer to “8.1 Add Comments” (p. 146).
When **[LAN]** is set as the save destination, **[Save Name]** is ignored and the files will be named in the previously-determined format.
Refer to “Save Operations (When Setting the Save Destination to [LAN])” (p. 93).

Save Name
- The maximum number of characters for **[Save Name]** is 123. The maximum path length including file name is 255 characters.
- A sequential number starting from 0001 is automatically appended to the Save Name (When **[New File]** is selected).

5 **Confirm the measurement configuration and numerical calculation result settings, then start measurement (Press the START key).**

After the data is acquired and the numerical calculation process completes, the numerical calculation results (text) are automatically saved to the specified storage media.

Example of Saving Numerical Calculation Results

When you save numerical calculation results, characters or display items used on the instrument are converted as shown below.

Characters used on the instrument	Saved characters
^{2}	^2
^{3}	^3
μ	~u
Ω	~o
ε	~e
°	~c
±	~+

<When calculation settings are as follows>
Calculation No. 1: Maximum value of analog channel 1
Calculation No. 2: Minimum value of analog channel 1
Calculation No. 3: Maximum value of analog channel 2
Calculation No. 4: Minimum value of analog channel 2

```
"Trig Time" ,"No1 Maximum Ch1" ,"No2 Minimum Ch1" ,"No3 Maximum Ch2" ,"No4 Minimum Ch2"
"","V","V","V","V"
"08-04-11 17:40:33.351","+3.00078E-05","+2.12000E-04","+2.00000E-03","+1.30000E-03"
"08-04-11 17:44:25.976","+3.06078E-05","+2.39996E-04","+2.00000E-03","+1.10000E-03"
```

Line 1: Calculation Settings
Line 2: Calculation Result Units
From Line 3: Calculation Results
Results are recorded in the order of the calculation settings of line 1.

If trigger time is not displayed properly when you open a file with Microsoft Excel®, select “Custom” for [Format] of [Format Cells] and enter “yy-mm-dd hh:mm:ss.000” for Type.

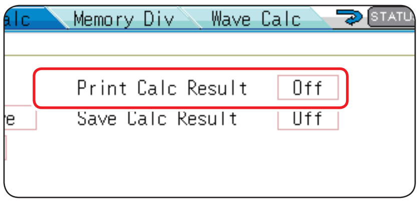
10.5 Print Numerical Calculation Results MEM

You can print the results of calculations.
When auto-print is enabled, the result data is printed after the waveform prints.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Num Calc]** sheet.

Move the cursor to [Print Calc Result], and select [On].

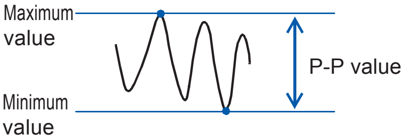
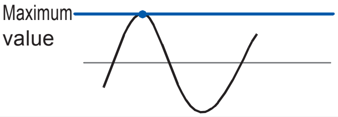
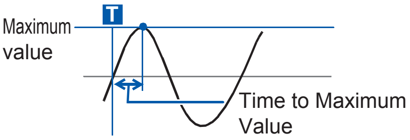
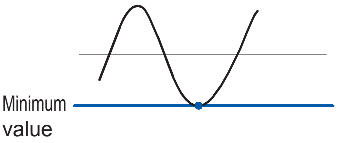
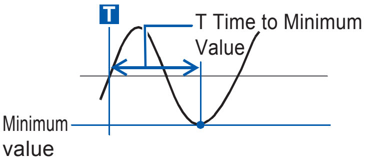
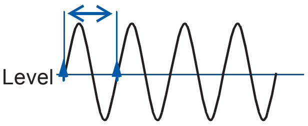


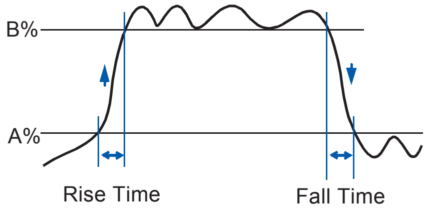
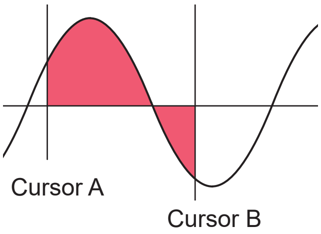
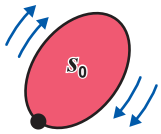
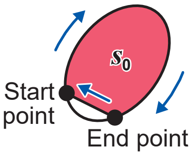
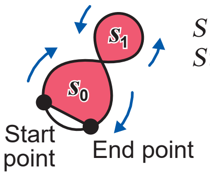
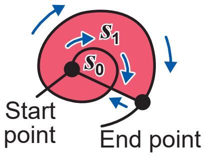
Print Calc Result Off
Save Calc Result Off

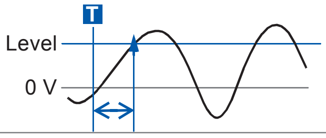
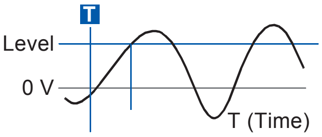
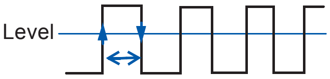
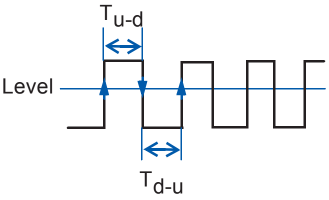
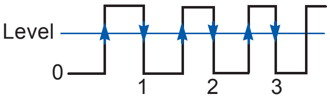
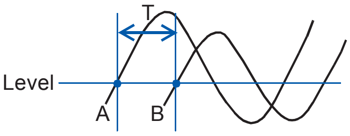
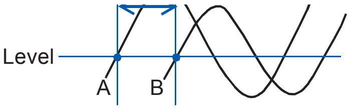
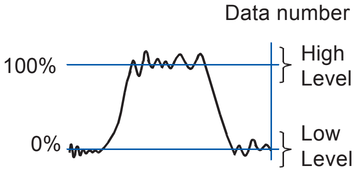
- Printing will also be carried out when only calculation was performed with no measurement.
- Calculation results are output to the output destination specified for automatic printing.

Refer to “6.2 Auto-print Settings” (p. 115)

10.6 Numerical Calculation Type and Description

Numerical calculation type	Description
Average	Calculates the average value of waveform data. $AVE = \frac{1}{n}\sum_{i=1}^{n} di$ *AVE*: Average *n*: Data count *di*: Data on channel number i
RMS (Root-Mean-Square) value (RMS)	Calculates the RMS value of waveform data. If Scaling is enabled, calculations are applied to the waveform after scaling. $RMS = \sqrt{\frac{1}{n}\sum_{i=1}^{n} di^2}$ *RMS*: RMS value *n*: Data count *di*: Data on channel number i
Peak-to-Peak value (Peak-Peak)	Calculates the value of the difference (peak-to-peak value) between maximum and minimum values of waveform data. 
Maximum Value (Maximum)	Finds the maximum value of waveform data. 
Time to Maximum Value (Max-Time)	Finds the time (in seconds) from the last trigger point to the maximum value. When there are two or more points with the maximum value, the first point of the first waveform used for the calculation is treated as the maximum value. 
Minimum Value (Minimum)	Obtains the minimum value of waveform data. 
Time to Minimum Value (Min-Time)	Finds the time (s) from the trigger point to the minimum value. When there are two or more points with the minimum value, the first point of the first waveform used for the calculation is treated as the minimum value. 
Period/Frequency	Displays the waveform's period (s) and frequency (Hz). Calculated based on the time difference between when the waveform first rises above or falls below the set level until it crosses again in the same direction. 

Numerical calculation type	Description
Rise Time and Falltime	The rise time of the acquired waveform from A% to B% (or fall time from B% to A%) is calculation using a histogram (frequency distribution) of the 0 and 100% levels of the acquired waveform. As waveform data is acquired, the rise time (or fall time) is determined from the first rising (or falling) edge. When calculating over the range specified by the AB cursors, the rise time (or fall time) is based on the first rising (or falling) edge between the cursors. The % value for A can be specified. The value for B is determined automatically based on the value of A, such as 95% when A is 5% and 70% when A is 30%.  A: 5% to 30% B: 95% to 70%
Standard Deviation (Std Dev)	Calculates the standard deviation of the waveform data. $\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(di - AVE)^2}$ σ: Standard Deviation *AVE*: Average *n*: Data count *di*: Data on channel number i
Area	Calculates the area value (V•s) enclosed by the zero position (point of zero potential) and the signal waveform. When calculating over the range specified by the AB cursors, the calculated area is constrained to the waveform between the cursors. $S = \sum_{i=1}^{n} \lvert di \rvert \bullet h$ *S*: Area *n*: Data count *di*: Data on channel number i *h*=Δt: Sampling rate 
X-Y Area	Calculates the area (V^2) of an X-Y composite waveform. In the following figures, the areas within the lines are calculated. The calculation is available even if the X-Y composite waveform is not intended for display. To enable area calculation, specify the calculation range using the AB cursors (Voltage axis or Trace) on the time-domain waveform of each channel for X-Y composition. (The area cannot be specified directly by AB cursors on the X-Y waveform.) About AB Cursor, refer to “7.1 Read Measurement Values (Using the AB Cursors)” (p. 128). **When multiple loops are plotted**  $S = n \times S_0$ *S*: Area *n*: Number of loops **When an open curve is plotted**  $S = S_0$ *S*: Area (Closed area is created by connecting the start and end points with a straight line) **When a figure of eight is plotted**  $S = \lvert S_0 - S_1 \rvert$ *S*: Area **When a spiral loop is plotted**  $S = S_0 \times 2 + S_1$ *S*: Area (The number of overlapping segments increases with a loop count) Setting Choices: Set the X- and Y-axis channels.

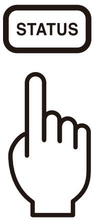
Numerical calculation type	Description
Time to Level (Time-Lev)	Finds the point where the signal crosses a specified level from the start of the calculation range, and calculates the time elapsed from the last trigger event. 
Specified Time Level (Lev-Time)	Finds the level at a specified time point after the trigger event. The time can also be specified using previously calculated results. 
Pulse Width	Calculates the pulse width as the time difference between one rising or falling intersection of the waveform through a specified level to the next intersection (with opposite slope). 
Duty Ratio (%)	Calculates the duty percentage based upon the ratio of the time from a rising intersection to the next falling intersection at a specified level, to the time from the same falling intersection to the next rising intersection at the same level.  $\text{Duty ratio (\%)} = \frac{Tu\text{-}d}{Tu\text{-}d + Td\text{-}u} \times 100(\%)$ T_{u-d}: Time (seconds) after rising intersection to falling intersection T_{d-u}: Time (seconds) after falling intersection to the next rising intersection
Pulses	Counts the pulses from the number of rising or falling intersections with a specified level. One pulse is counted when the signal falls back below the specified level after rising through it (or vice versa) 
Four Arithmetic Operations (Calculation)	Performs arithmetic operations (+, - , ×, ÷) upon arbitrarily selected results of numerical calculations.
Time difference calculation (Time Diff)	Calculates T[s], the time difference that passes between rising above or dropping below the level specified for A and B waveforms. Time difference T = B waveform (time when the level was exceeded) - A waveform (time when the level was exceeded). 
Phase diffrence calculation (Phase Diff)	Calculates the time difference between rising above or dropping below the level specified for A and B waveforms and then calculates the phase diffrence [°], based on waveform A.  $\text{Phase contrast} = \frac{\text{Time difference of A and B waveform [T]}}{\text{Cycle of A waveform}} \times 360\ [°]$
High Level Low Level	With 0% of the loaded waveform data as the Low level and 100% as the High level, a histogram (frequency distribution) is used for calculation. 

11 Waveform Calculation Functions

MEM

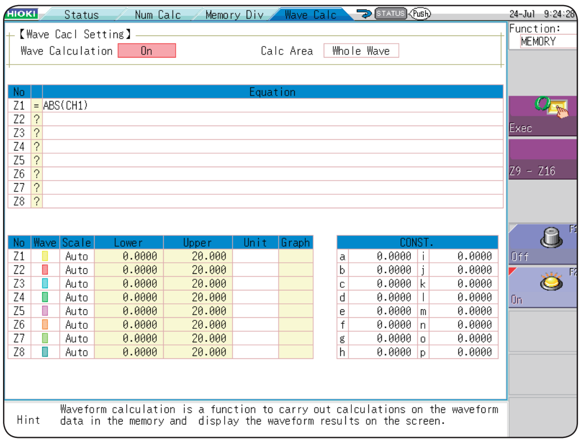
Waveform calculations can only be used with the Memory function.
A pre-specified calculation equation is applied to acquired waveform data and the calculated results are displayed as a waveform on the Waveform screen.
Waveform calculation settings are made on the Status screen - **[Wave Calc]** sheet.

To Open the [Wave Calc] Sheet



Press this key repeatedly to display the various sheets.

[Status] ← **[Wave Calc]**
↓ ↑
[Num Calc] → **[Memory Div]**



24-Jul 9:24:28

Function: MEMORY

【Wave Cacl Setting】
Wave Calculation On
Calc Area Whole Wave

No		Equation
Z1	=	ABS(CH1)
Z2	?	
Z3	?	
Z4	?	
Z5	?	
Z6	?	
Z7	?	
Z8	?	

No	Wave	Scale	Lower	Upper	Unit	Graph
Z1	🟨	Auto	0.0000	20.000		
Z2	🟥	Auto	0.0000	20.000		
Z3	🟦	Auto	0.0000	20.000		
Z4	🟩	Auto	0.0000	20.000		
Z5	🟪	Auto	0.0000	20.000		
Z6	🟧	Auto	0.0000	20.000		
Z7	🟩	Auto	0.0000	20.000		
Z8	🟦	Auto	0.0000	20.000		

CONST.			
a	0.0000	i	0.0000
b	0.0000	j	0.0000
c	0.0000	k	0.0000
d	0.0000	l	0.0000
e	0.0000	m	0.0000
f	0.0000	n	0.0000
g	0.0000	o	0.0000
h	0.0000	p	0.0000

Hint Waveform calculation is a function to carry out calculations on the waveform data in the memory and display the waveform results on the screen.

Operations Available From the [Wave Calc] Sheet

Waveform Calculations

- Four Arithmetic Operators (+, -, *, /)
- Absolute Value (ABS)
- Exponent (EXP)
- Common Logarithm (LOG)
- Square Root (SQR)
- Moving Average (MOV)
- Parallel displacement along the time axis
- Differential Calculus: 1st derivative (DIF), 2nd derivative (DIF2)
- Integral Calculus: 1st integral (INT), 2nd integral (INT2)
- Trigonometric functions (SIN, COS TAN)
- Inverse Trigonometric functions (ASIN, ACOS ATAN)
- MR8990 Digital Voltmeter Unit PLC delay shift (PLCS)

(12 types in total)

- Specified calculation between AB cursors
  Waveform calculations can be limited to data within the range specified by AB cursors.

Calculation operator details:
“11.3 Waveform Calculation Operators and Results” (p. 242)

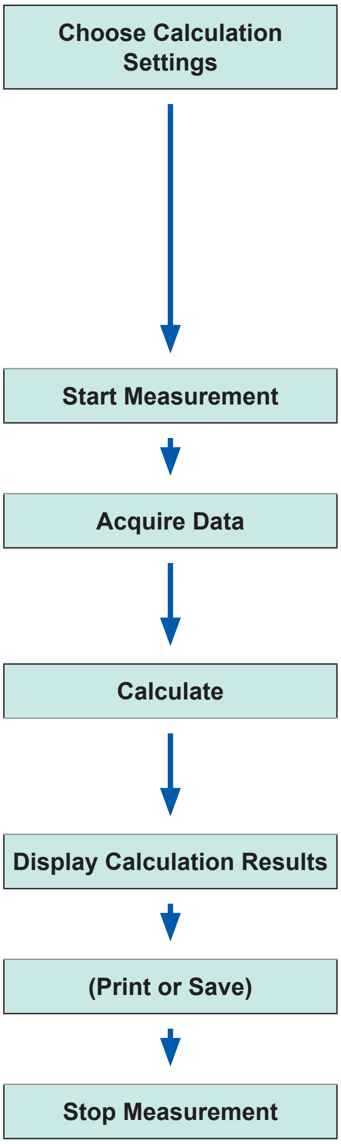
In addition to the four arithmetic operators, 11 types of functions can be used. It is possible to set up to 16 calculation formulas.
When Scaling is enabled, numerical calculations are performed on scaled values.

11.1 Waveform Calculation Workflow

There are two different ways of performing calculation.

• **Calculate While Measuring:**	Settings for waveform calculation must be chosen before starting measurement.
• **Apply Calculations to Existing Data:**	Calculation can be performed on waveform data after measurement is completed, and for data saved on storage media.

Calculate While Measuring



Choose calculation settings on the [Wave Calc] sheet. (p. 236)

To automatically print or save calculation results, choose printing and saving settings before starting measurement.
- Save calculation results automatically (p. 88)
- Print calculation results automatically (p. 115)

The instrument acquires data when the trigger criteria are met.
(If triggering is not enabled, the instrument acquires data when you press the **START** key.)

[Calculating...] appears on the screen.
Calculations are performed sequentially from No. 1 to No. 16.
(To interrupt calculation, press the **STOP** key to abort)

Results will be displayed on the Waveform screen. (p. 237)

(If auto-printing or auto-saving are set to [On].)
Calculation results are automatically printed or saved.

- Waveform calculation is not available when using Roll Mode or Memory Division.
- If waveform calculation is performed during measurement and you force the instrument to stop during calculation, the result of calculations already performed when calculation is canceled will be displayed. To re-calculate, select the **[Exec]** button at the **[Wave Calc]** sheet.

Apply Calculations to Existing Data

After measurement with calculation OFF (Or after loading data)	**(To load measurement data from storage media for calculation)**	(p. 99)
Choose Calculation Settings	**Choose calculation settings on the [Wave Calc] sheet**	(p. 236)
Execute Calculation	**Select [Exec] to execute calculations.** (To interrupt calculation, press the **STOP** key)	
Display Calculation Results	**Results will be displayed on the Waveform screen.**	(p. 237)
(Print or Save)	**Print or save calculation results as needed.** • Print: **PRINT** key • Save: **SAVE** key	

- The maximum recording length that can be calculated is 40,000 div.
- To perform calculation on waveforms that are longer than the maximum recording length, save the files in sections with ranges shorter than the maximum recording length, then reload the files into the instrument, and perform the calculation.
- Up to 16 previously measured waveforms can be referenced when memory division is **[OFF]**. If waveform calculations have been conducted for these waveforms, waveform data will be deleted except for the currently referenced block (the block that includes calculation data)..

To specify a waveform range for calculation

Before executing a calculation, specify the calculation range using the AB cursors (div or Trace cursors) on the Waveform screen. Set the calculation range on the **[Wave Calc]** sheet to **[A-B Wave]**.

- Range cursors cannot be used to specify the range.
- When one cursor is used, the calculation range is from the cursor to the end of the data.

Post-measurement waveform calculation cannot be performed for waveforms measured in excess of the maximum recording length, even if a range is specified with the A and B cursors. To perform waveform calculation for waveforms with a longer recording length, save a subset of the waveform that is shorter than the maximum recording length to a separate file, load that file back into the instrument, and then perform the calculation.

Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131) or “11.2 Waveform Calculation Settings” (p. 236).

To change calculation settings and recalculate

Make changes to calculation contents on the **[Wave Calc]** sheet, and execute the calculation.

Refer to “11.2 Waveform Calculation Settings” (p. 236).

When calculation waveform is not displayed or when you want to display only a desired waveform

The displayed sheet and calculation waveform to be displayed can be selected on the **[Wave Calc]** sheet.

Refer to “11.2.3 Change the Display Method for Calculated Waveforms” (p. 240).

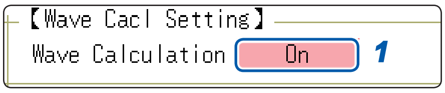
11.2 Waveform Calculation Settings

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Wave Calc]** sheet.

1 **Enable the Waveform Calculation function.**

Move the cursor to **[Wave Calculation]**, and select **[On]**.

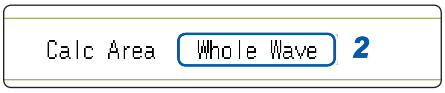


【Wave Cacl Setting】

Wave Calculation On

2 **Specify the waveform calculation range.**

Move the cursor to **[Calc Area]**.



Calc Area Whole Wave

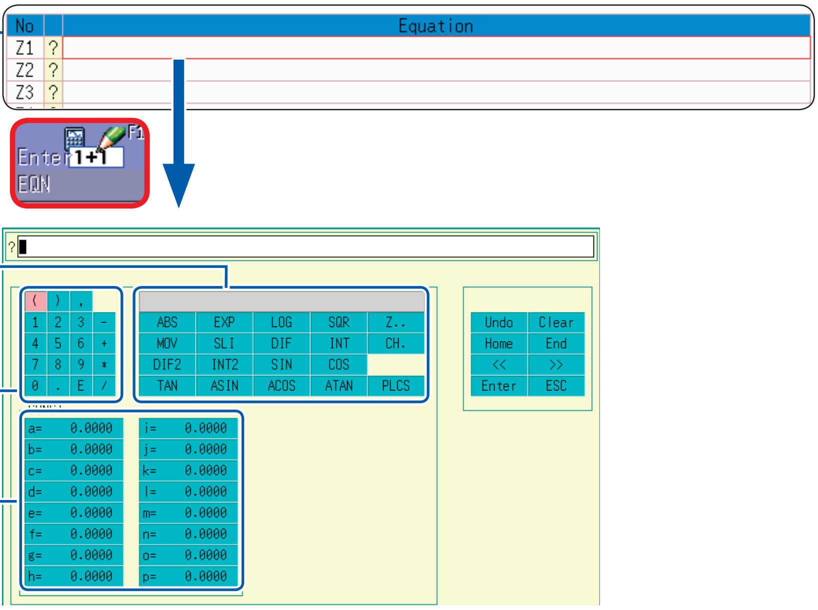
Whole Wave	Applies calculations to the whole waveform. *(Default setting)*
A-B Wave	Applies calculations to the data between AB cursors.

Refer to “7.2 Specify a Waveform Range (AB Cursor)” (p. 131).

When selecting **[A-B Wave]**, specify the calculation range using the AB cursors on the Waveform screen.
If no measurement data has been acquired by the instrument, first measure once so that the range can be specified for calculations to be applied to subsequent measurements
The calculation result will be 0 for the part outside of the range of the AB cursor.

3 **Perform calculation settings.**

Move the cursor to the **[Equation]** column of the calculation to be set and select **[Enter EQN]**.
A dialog is displayed for entering a calculation equation.



Calculation No.

Enter calculation operators

Enter numerical values and symbols

Enter constants
Constants must have been previously entered on the **[CONST.]**. (p. 239)

4 **Select a calculation equation.**

Refer to “Waveform Calculation Example: Calculate the RMS waveform from the instantaneous waveform” (p. 241).

5 **Select [Confirm] when entry is finished.**

The entered equation is displayed in the **[Equation]** field.
The scale (maximum and minimum values) of the calculation results has a default setting of **[Auto]**. If you want to scale the results, set the maximum and minimum values under **[Manual]**.
Refer to “Change the Display Method for Calculated Waveforms” (p. 240).

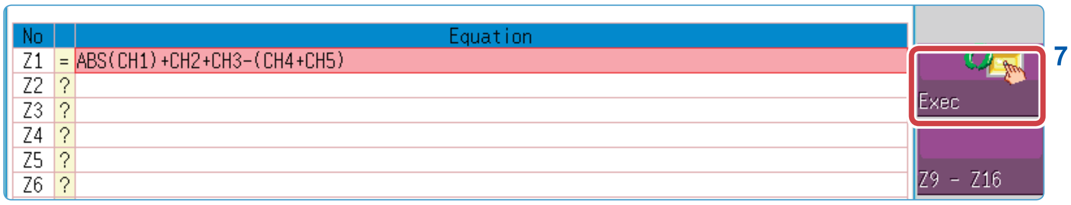
If “=” is displayed
The entered calculation equation is syntactically correct.
If “?” is displayed
The equation has a syntax error.
The cursor is placed at the location of the error to facilitate correction.
- Are parentheses correctly matched?
- Has a multiplication operator “*” been omitted?

6 **(If necessary)**
Set auto-saving (p. 88) and auto-printing (p. 115).

7 **Execute the calculation.**

Apply Calculations to Existing Data

At the **[Wave Calc]** sheet, select **[Exec].**



No		Equation
Z1	=	ABS(CH1)+CH2+CH3-(CH4+CH5)
Z2	?	
Z3	?	
Z4	?	
Z5	?	
Z6	?	

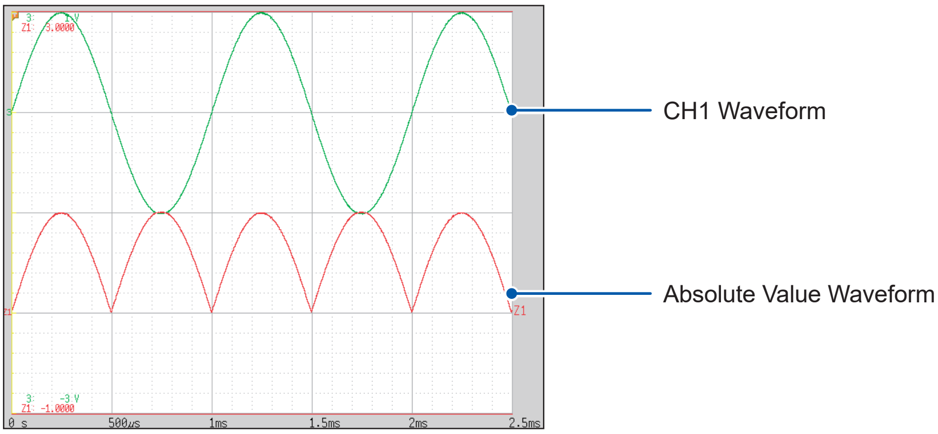
To calculate while measuring

Press the **START** key to start measurement.
Calculation waveforms are displayed after loading waveforms.

11.2.1 Display the Trigger Settings to Search Measurement Data

The results of waveform calculation are displayed on the Waveform screen.

Example: Calculate the absolute value of the waveform of CH1.
Calculation equation = ABS(CH1)



To copy settings from one calculation to another

Settings can be copied at the **[Wave Calc]** sheet.
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169)

About Calculation Equations

Operators

Operators	Name	Operators	Name
ABS	Absolute Value	DIF2	2nd Derivative
EXP	Exponent	INT2	2nd Integral
LOG	Common Logarithm	SIN	Sine
SQR	Square Root	COS	Cosine
MOV	Moving Average	TAN	Tangent
SLI	Parallel displacement along the time axis	ASIN	Inverse Sine
DIF	1st Derivative	ACOS	Inverse Cosine
INT	1st Integral	ATAN	Inverse Tangent
		PLCS	PLC delay shift

Refer to “11.3 Waveform Calculation Operators and Results” (p. 242).

To Enter Calculation Equations

- Each calculation equation may contain up to 80 characters.
- Each constant in a calculation equation may contain up to 30 digits.
- For multiplication, use [*]. For division, use [/].
- Entering a long, complex formula such as that shown below will cause **[?]** to be displayed. Separate the formula into two shorter formulas.

$$\underbrace{\text{ABS(CH1)}}_{1}+\underbrace{\text{CH2*CH3}}_{2}\text{-}\underbrace{\text{(CH4+CH5)*AB}}_{3}$$

- If a formula tries to divide by 0, an overflow value will be output.
  (For positive values, +9.9999E+29. For negative values, −9.9999E+29.)
- The result of calculation Z_i can be used in other calculation equations. However, the Z_nth equation can only refer to the results of equations up to Z_{n-1}.
  (Example: Equation Z_4 can include the results of equations Z_1 through Z_3.)

Using the MOV, SLI, DIF and DIF2 operators in an equation (The second parameter)

Set a number after the comma within the parenthesis (_,#) for each of these calculation operators.

Operators	Settings	Setting Examples
MOV (Moving Average) **SLI** (Horizontal Movement)	**Set the number of moving points to average over.** Setting Range MOV (Moving Average): 1 to 5000 SLI: −5000 to 5000	Calculate the 10-point moving average of CH1: MOV(CH1,10)
DIF (Derivative) **DIF2** (2nd Derivative)	**Specify the sampling interval over which to calculate the derivative.** “1” is normally acceptable, but this should be set larger to capture fluctuation values of slowly changing waveforms. DIF and DIF2 Setting Range: 1 to 5000	Calculate the derivative of CH2 using a 20-point sampling interval: DIF(CH2,20)

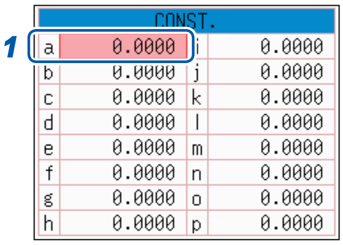
When calculation results overflow (OVER)

- The value at the AB cursor is not a correct value.
- When **[Scale]** is set to **[Auto]**, waveforms appear at the top or bottom edge of the screen. This makes calculation result overflow obvious.

11.2.2 Setting Constants

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Wave Calc]** sheet.



CONST.

a	0.0000	i	0.0000
b	0.0000	j	0.0000
c	0.0000	k	0.0000
d	0.0000	l	0.0000
e	0.0000	m	0.0000
f	0.0000	n	0.0000
g	0.0000	o	0.0000
h	0.0000	p	0.0000

1 **Move the cursor to the No. in the [CONST.] section you want to set.**

2 **Select an entry method, and enter the constant.**

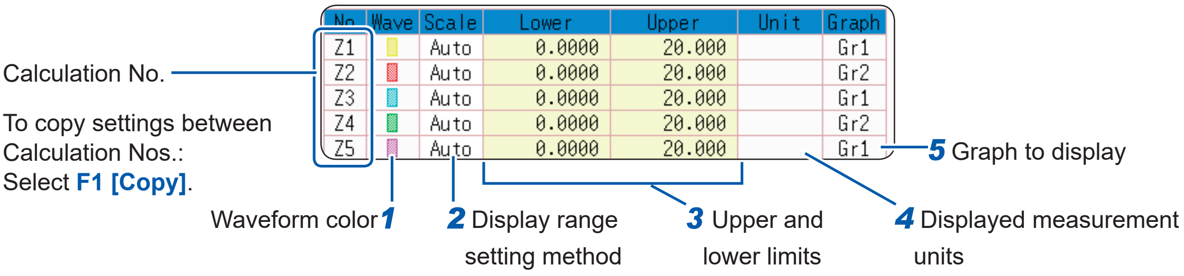
Setting Range: −9.9999E+29 to +9.9999E+29
Refer to “8.1.3 Alphanumeric Input” (p. 149).

Defined constants are shown in the constant display of the calculation equation setting dialog.

11.2.3 Change the Display Method for Calculated Waveforms

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Wave Calc]** sheet.



No.	Wave	Scale	Lower	Upper	Unit	Graph
Z1	🟨	Auto	0.0000	20.000		Gr1
Z2	🟥	Auto	0.0000	20.000		Gr2
Z3	🟦	Auto	0.0000	20.000		Gr1
Z4	🟩	Auto	0.0000	20.000		Gr2
Z5	🟪	Auto	0.0000	20.000		Gr1

Calculation No.
To copy settings between Calculation Nos.: Select F1 [Copy].
Waveform color 1
2 Display range setting method
3 Upper and lower limits
4 Displayed measurement units
5 Graph to display

1 Enable waveform display and display color

Move the cursor to the **[Wave]** column.

On-Off	Set On to display the waveform of the calculation No. for the currently selected row *(Default setting)*. Set to Off to not display this waveform.
↑↓	Select the waveform color.
All On-Off	Select On to display all waveforms. Select Off to hide all waveforms.

2 Select a method to set scaling

Move the cursor to the **[Scale]** column for the Calculation No. you want to adjust.

Auto	Automatically sets the display range of the vertical axis. (After calculation, the upper and lower limits are obtained from the results, and set automatically.)
Manual	Upper and lower limits of the vertical axis display range are entered manually.

Depending on calculation results, automatic scaling settings may be unsatisfactory,
in which case the limits must be entered manually.

3 Set the upper and lower limits of the display range (When [Manual] is selected)

Select **[Lower]** and **[Upper]**.
Select an entry method and enter the limit values.
Entry range: −9.9999E+29 to +9.9999E+29
Refer to “8.1.3 Alphanumeric Input” (p. 149).

4 Specify the physical units.

Move the cursor to the **[Unit]** column.
Select an entry method and enter the physical units.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

5 Select the graph to be displayed.

(When the split screen [Format] item on the [Status] sheet is **[Dual]** or higher)
Move the cursor to the **[Graph]** column and select the graph number.

Waveform Calculation Example: Calculate the RMS Waveform From the Instantaneous Waveform

This example shows how the RMS values of the waveform input on Channel 1 can be calculated and displayed. The process below shows calculation on waveform data measured for one cycle over two divisions.

1 **Enable the Waveform Calculation function.**

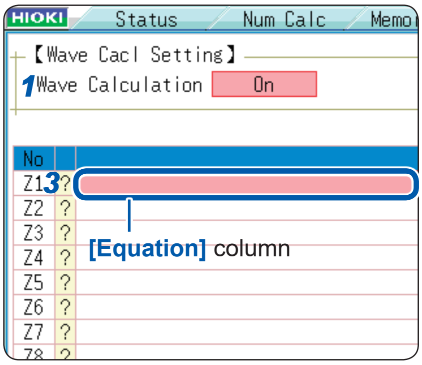
Move the cursor to **[Wave Calculation]**, and select **[On]**.

2 **Specify the waveform calculation range.**

Move the cursor to **[Calc Area]**, and select [**Whole Area]**.

3 **Set a calculation equation.**

Move the cursor to the **[Equation]** column of No. Z1 and then select **[Enter EQN]**.
A dialog is displayed for entering a calculation equation.



【Wave Cacl Setting】
Wave Calculation On

[Equation] column

Characters are entered before the black cursor. Errors are indicated by red cursors.

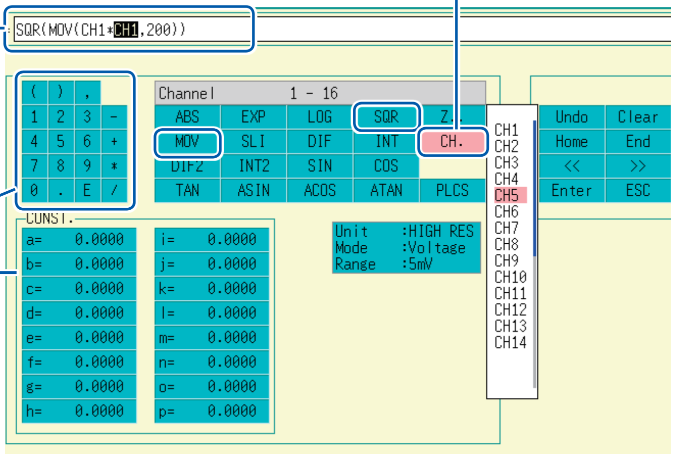
After selecting the channel number, select **[Enter Char]**.

Enter the calculation equation
SQR(MOV(CH1*CH1,200))

The number of samples per cycle (1 division = 100 samples).
Here, one cycle is two divisions (200 samples).

Enter numerical values and symbols

It is convenient to set constants beforehand on the **[CONST.]** area.
(p. 239)



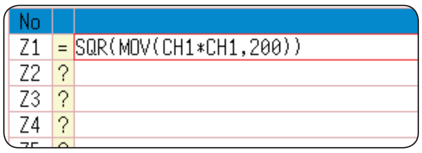
SQR(MOV(CH1*CH1,200))

a= 0.0000
b= 0.0000
c= 0.0000
d= 0.0000
e= 0.0000
f= 0.0000
g= 0.0000
h= 0.0000
i= 0.0000
j= 0.0000
k= 0.0000
l= 0.0000
m= 0.0000
n= 0.0000
o= 0.0000
p= 0.0000

Unit :HIGH RES
Mode :Voltage
Range :5mV

4 **Select [Confirm] when entry is finished.**

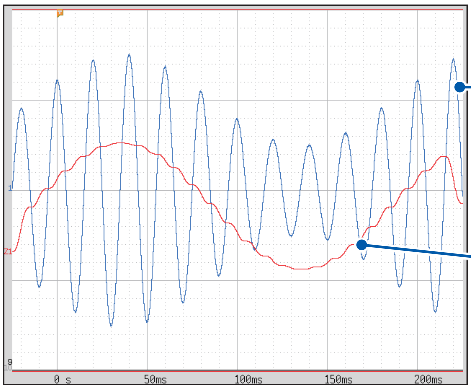
The entered equation is displayed in the **[Equation]** field.



Z1 = SQR(MOV(CH1*CH1,200))

5 **Execute the calculation.**

Press the **START** key to start measurement.
The calculation waveform is displayed after acquiring the input waveform.



CH1 Waveform

Calculated waveform of RMS values

To view calculated waveforms of loaded data, navigate to the **[Wave Calc]** sheet and select **[Exec]**.

11.3 Waveform Calculation Operators and Results

b_i: ith member of calculation result data, d_i: ith member of source channel data

Waveform calculation type	Description
Four Arithmetic Operators (+, −, *, /)	Executes the corresponding arithmetic operation.
Absolute Value (ABS)	$b_i = \mid d_i \mid$ $(i = 1, 2, ... n)$
Exponent (EXP)	$b_i = exp(d_i)$ $(i = 1, 2, ... n)$
Common Logarithm (LOG)	When $d_i > 0$ $b_i = log_{10}\, d_i$ When $d_i = 0$ $b_i = -\infty$ (overflow value output) When $d_i < 0$ $b_i = log_{10} \mid d_i \mid$ $(i = 1, 2, ... n)$ Note: Use the following equation to convert to natural logarithm calculations. $LnX = log_eX = log_{10}X / log_{10}e$ $1 / log_{10}e \approx 2.30$
Square Root (SQR)	When $d_i \geq 0$ $b_i = \sqrt{d_i}$ When $d_i < 0$ $b_i = \sqrt{\mid d_i \mid}$ $(i = 1, 2, ... n)$
Moving Average (MOV)	When k is odd $bi = \frac{1}{k} \sum_{t=i-\frac{k}{2}}^{i+\frac{k}{2}}$ $(i=1,2, ...n)$ When k is even $bi = \frac{1}{k} \sum_{t=i-\frac{k}{2}+1}^{i+\frac{k}{2}}$ $(i=1,2, ...n)$ dt: tth member of source channel data k : number of points to move (1 to 5000) 1 div = 100 points. k is specified after a comma. (Ex.) To make Z1 the moving average of 100 points: MOV(Z1,100) For k/2 data at the beginning and end of the calculation section, the places that lack data are filled with 0s before calculation.
Parallel displacement along the time axis (SLI)	Moves waveforms along the time axis by the specified distance. $b_i = d_{i-k}$ $(i = 1, 2, ... n)$ k : number of points to move (−5000 to 5000) k is specified after a comma. (Ex.) To slide Z1 by 100 points along the time axis: SLI(Z1,100) Note: When sliding a waveform, if there is no data at the beginning or end of the calculation result, the voltage value becomes zero. 1 div = 100 points.
Sine (SIN)	$b_i = sin(d_i)$ $(i = 1, 2, ... n)$ Trigonometric and inverse trigonometric functions employ radian (rad) units.
Cosine (COS)	$b_i = cos(d_i)$ $(i = 1, 2, ... n)$ Trigonometric and inverse trigonometric functions employ radian (rad) units.
Tangent (TAN)	$b_i = tan(d_i)$ $(i = 1, 2, ... n)$ where $-10 \leq bi \leq 10$ Trigonometric and inverse trigonometric functions employ radian (rad) units.
Arcsine (ASIN)	When $d_i > 1$ $b_i = \pi / 2$ When $-1 \leq d_i \leq 1$ $b_i = asin(d_i)$ When $d_i < 1$ $b_i = -\pi / 2$ Trigonometric and inverse trigonometric functions employ radian (rad) units.
Arccosine (ACOS)	When $d_i > 1$ $b_i = 0$ When $-1 \leq d_i \leq 1$ $b_i = acos(d_i)$ When $d_i < -1$ $b_i = \pi$ $(i = 1, 2, ... n)$ Trigonometric and inverse trigonometric functions employ radian (rad) units.
Arctangent (ATAN)	$b_i = atan(d_i)$ $(i = 1, 2, ... n)$ Trigonometric and inverse trigonometric functions employ radian (rad) units.

b_i: ith member of calculation result data, d_i: ith member of source channel data

Waveform calculation type	Description
First derivative (DIF) **Second derivative (DIF2)**	The first and second derivative calculations use a fifth-order Lagrange interpolation polynomial to obtain a point data value from five sequential points. d_1 to d_n are the derivatives calculated for sample times t_1 to t_n. Note: Scattering of calculation results increases when a slowly changing waveform is differentiated. If scattering is excessive, try to increase the value of the second parameter of the function. Refer to “Using the MOV, SLI, DIF and DIF2 operators in an equation (The second parameter)” (p. 238). The following equations are the cases where the value of the second parameter is 1. **Formulas for the first derivative** Point t_1 $b_1 = (-25d_1 + 48d_2 - 36d_3 + 16d_4 - 3d_5)/\ 12h$ Point t_2 $b_2 = (-3d_1 - 10d_2 + 18d_3 - 6d_4 + d_5)/\ 12h$ Point t_3 $b_3 = (d_1 - 8d_2 + 8d_4 - d_5)/\ 12h$ ↓ Point t_i $b_i = (d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2})/\ 12h$ ↓ Point t_{n-2} $b_{n-2} = (d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n)/12h$ Point t_{n-1} $b_{n-1} = (-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n)/12h$ Point t_n $b_n = (3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n)/12h$ b_1 to b_n: calculation results $h = \Delta t$: Sampling Period **Formulas for the second derivative** Point t_1 $b_1 = (35d_1 - 104d_2 + 114d_3 - 56d_4 + 11d_5)/12h^2$ Point t_2 $b_2 = (11d_1 - 20d_2 + 6d_3 + 4d_4 - d_5)/12h^2$ Point t_3 $b_3 = (-d_1 + 16d_2 - 30d_3 + 16d_4 - d_5)/12h^2$ ↓ Point t_i $b_i = (-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - \mathrm{d}_{i+2})/12h^2$ ↓ Point t_{n-2} $b_{n-2} = (-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n)/12h^2$ Point t_{n-1} $b_{n-1} = (-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n)/12h^2$ Point t_n $b_n = (11 - d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n)/12h^2$

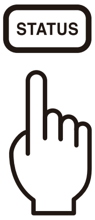
b_i: ith member of calculation result data, d_i: ith member of source channel data

Waveform calculation type	Description
First integral (INT) **Second integral (INT2)**	First and second integrals are calculated using the trapezoidal rule. d_1 to d_n are the integrals calculated for sample times t_1 to t_n. **Formulas for the first integral** Point t_1 $I_1 = 0$ Point t_2 $I_2 = (d_1 + d_2)h/2$ Point t_3 $I_3 = (d_1 + d_2)h/2 + (d_2 + d_3)h/2 = I_2 + (d_2 + d_3)h/2$ ↓ Point t_n $I_n = I_{n-1} + (d_{n-1} + d_n)h/2$ I_1 to I_n: calculation results $h = \Delta t$: Sampling period **Formulas for the second integral** Point t_1 $II_1 = 0$ Point t_2 $II_2 = (I_1 + I_2)h/2$ Point t_3 $II_3 = (I_1 + I_2)h/2 + (I_2 + I_3)h/2 = II_2 + (I_2 + I_3)h/2$ ↓ Point t_n $II_n = II_{n-1} + (I_{n-1} + I_n)h/2$ II_1 to II_n: calculation results Note: Integration is greatly affected by subtle deviation in the zero position. Be sure to perform zero adjustment before measurement. In some cases, you may need to correct zero point deviation further. Example: To shift the zero position by 0.124 mV Z1 = INT(CH1 − 0.000124)
Digital voltmeter unit PLC delay shift (PLCS)	Shifts the time by the length the frequency (PLC) delay or NPLC delay set with the MR8990 Digital Voltmeter Unit. Since the digital voltmeter unit obtains the average during the period set with the NPLC, it observes the waveform that delays half the period of the NPLC compared with the 8966 Analog Unit. The PLCS calculation shifts the time by the length of this delay to correct the deviation from the analog unit. Note: If there is no data at the end of the calculation result, the voltage value becomes zero.

12 Memory Division Function MEM

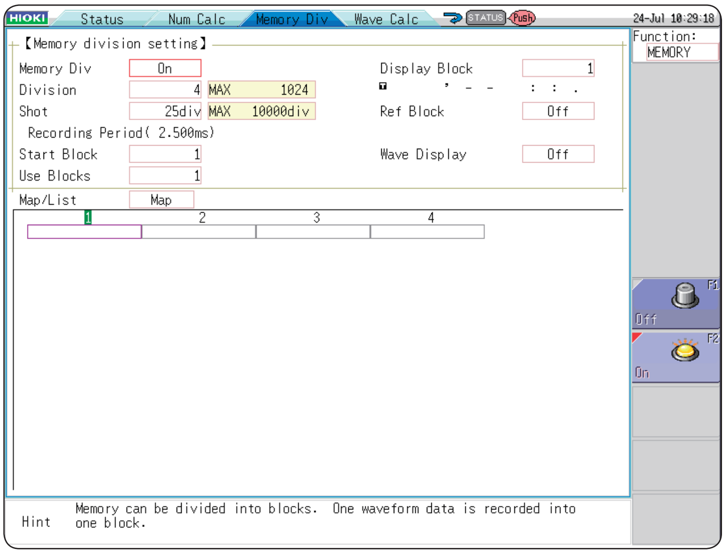
The Memory division function can only be used with the Memory function.
Memory division settings are made on the Status screen - **[Memory Div]** sheet.
Blocks to be displayed can also be selected on the Waveform screen (p. 143).

To Open the [Memory Div] Sheet



Press this key repeatedly to display the various sheets.

[Status] ← **[Wave Calc]**
↓ ↑
[Num Calc] → **[Memory Div]**



【Memory division setting】

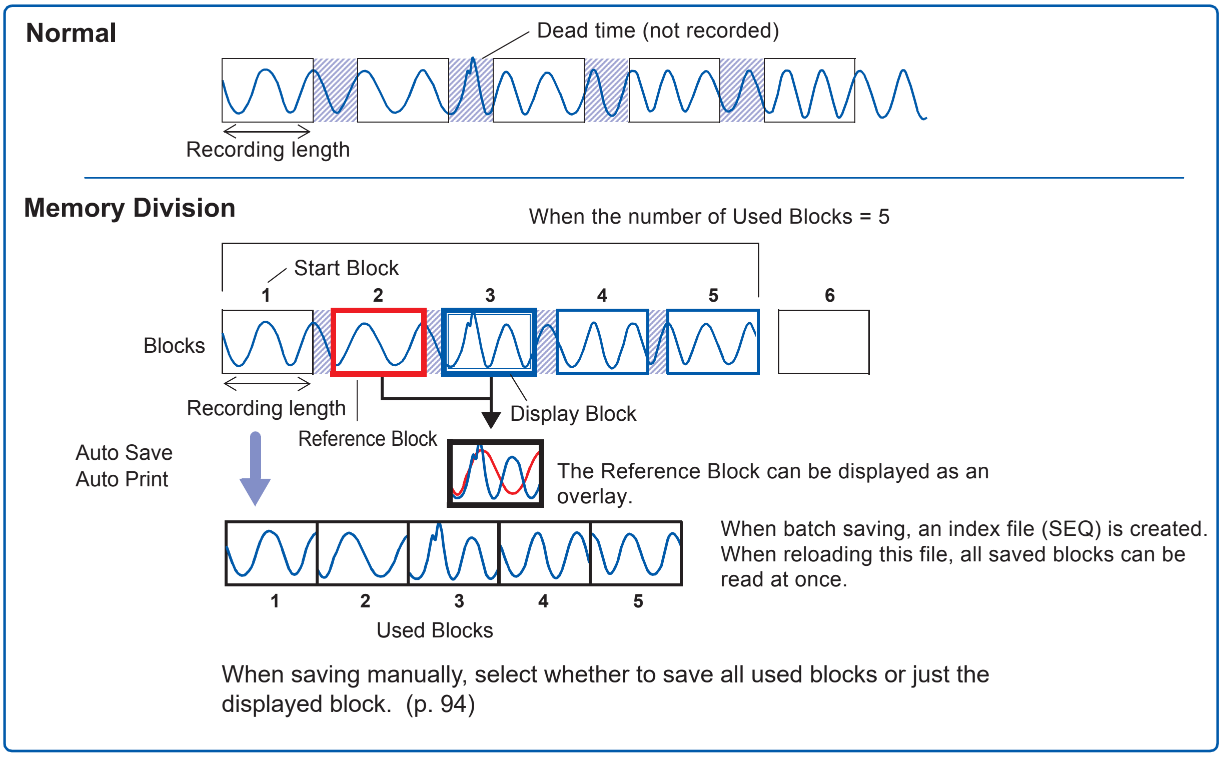
Memory Div On
Division 4 MAX 1024
Shot 25div MAX 10000div
Recording Period(2.500ms)
Start Block 1
Use Blocks 1
Display Block 1
Ref Block Off
Wave Display Off
Map/List Map
Function: MEMORY

Hint Memory can be divided into blocks. One waveform data is recorded into one block.

> When using memory division, the trigger output (TRIG_OUT terminal output) may output the Low level or output erratically under the following conditions.
> - The timebase is 5 μs/div to 100 μs/div
> - The record (measurement) time is 5 ms or less
> - Tracking wave display is **[Off]**.

Operations Available From the [Memory Div] Sheet

- Waveforms can be recorded into individual blocks by dividing memory space into multiple blocks.
- You can record waveforms beginning at any block (**Start Block**), choose which blocks to display (**Display Block**), or display multiple overlaid blocks (**Reference Block**).
- The maximum number of blocks for memory division depends on the installed memory board and recording length (up to 1024 divisions).
- Triggered waveform data can be acquired continuously and recorded sequentially in specified blocks (from the Start Block, for the specified Used Blocks). Dead time while displaying or printing (during which triggers are ignored) can be minimized.
- Even if you do not use the Memory Division function, up to 16 blocks of data (depending on the specified recording length) can be saved to each block so that previously recorded data can be selected for display on the Waveform Screen.
  Refer to “7.8 View Block Waveforms” (p. 143).



The Reference Block can be displayed as an overlay.

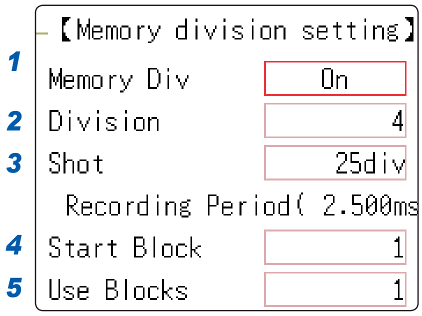
When batch saving, an index file (SEQ) is created. When reloading this file, all saved blocks can be read at once.

When saving manually, select whether to save all used blocks or just the displayed block. (p. 94)

12.1 Recording Settings

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Memory Div]** sheet.



【Memory division setting】

1 Memory Div: On

2 Division: 4

3 Shot: 25div

Recording Period(2.500ms

4 Start Block: 1

5 Use Blocks: 1

1 **Enable the Memory Division function.**

Move the cursor to **[Memory Div]**.
Select **[On]**.

Off	Memory Division is disabled. *(Default setting)*
On	Memory Division is enabled.

2 **Set the number of divisions.**

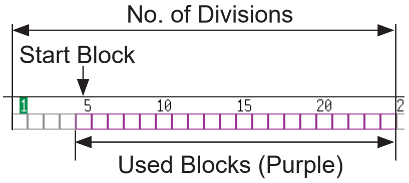
Move the cursor to **[Division]**.
Set the number of blocks for division.
Default setting: 4

3 **Set the recording length.**

(This is linked to the recording length setting on the **[Status]** sheet.)
Move the cursor to **[Shot]**.
Set the recording length.
The maximum recording length and number of divisions are determined automatically according to memory capacity and the number of channels used.
Setting Range: “Appendix 2.4 Maximum recording length and number of divisions (Memory division function)” (p. A7)

Memory Division, Waveform Calculation, and Roll Mode cannot be enabled at the same time.

When the number of divisions is 32, the Start Block is 5 and the Used Block number (number of blocks to use) is 20



4 **Set the start block.**

Move the cursor to **[Start Block]**.
Set the block number at which to start recording.
Default setting: 1

5 **Set the number of Used Blocks.**

Move the cursor to **[Use Blocks]**.
Set the number of blocks to use.
Default setting: 1

About Recording

When a faster timebase is selected, display, print and save operations are not available during measurement.
Selecting the displayed screen for auto saving lengthens dead time.

To display any block on the waveform screen when finished measuring

Set the number of blocks to display (p. 248)
(This can also be set on the Waveform screen (p. 143).)

To display overlaid waveforms

Set the number of blocks for reference (p. 248).

12.2 Display Settings

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Memory Div]** sheet.

1 **To display any block on the Waveform screen**

Set the display blocks

Set after measurement is complete. (This can also be set on the Waveform screen (p. 143).)
Move the cursor to **[Display Block]**.
Set the number of blocks to display on the Waveform screen.

2 **To display multiple blocks as overlaid waveforms**

Enable the Reference Block function

Move the cursor to **[Ref Block]**.
Select **[On]**.

Off	Reference Blocks are not displayed *(Default setting)*
On	Reference Blocks overlay Display blocks on the display.

3 **(When Reference Blocks are enabled [On])**

Select whether to reference every block

To overlay all waveforms, select **[All Blks On]**.

All Blks Off	Turn off reference to all blocks.
All Blks On	Turn on reference to all blocks.

To overlay selected waveforms, move the cursor to the number column of the reference block and select the block number.

Ref On-Off	Set On or Off. If **[On]** is selected, the block frame of the selected block number is displayed as a green square.
↑↓	Select a block.

4 **To display every block as its waveform is acquired**

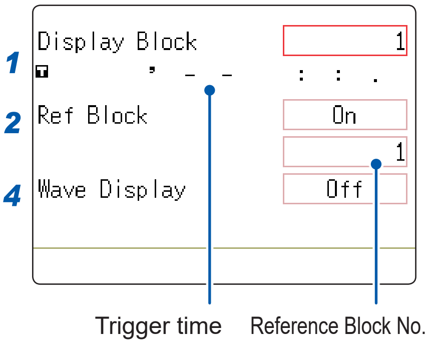
Enable tracking waveform display.

Move the cursor to **[Wave Display]**.
Select **[On]**.

Off	The waveform of the specified Display Block will be displayed after recording the specified number of Used Blocks. *(Default setting)*
On	Waveforms are displayed one block at a time as they are acquired at each trigger event.

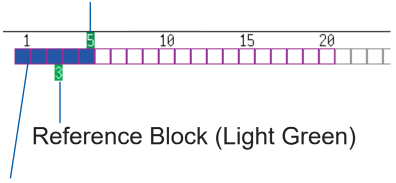
To View Memory Division waveforms on the Waveform screen

Refer to “7.8 View Block Waveforms” (p. 143)



Display Block 1
Ref Block On 1
Wave Display Off

When the Display Block is 5 and the Reference Block is 3



The colored blocks indicate blocks where measurement data has been recorded.

Reference Block Selection
Reference Blocks can also be selected and deselected using **[Ref Block]** on the [List] display.
Refer to “To get details on each block” (p. 249).

Setting the Trace Waveform display to [On] lengthens dead time.
About Dead Time:
Refer to “Difference Between Dead Times During Normal and Memory Division Recording” (p. 250).

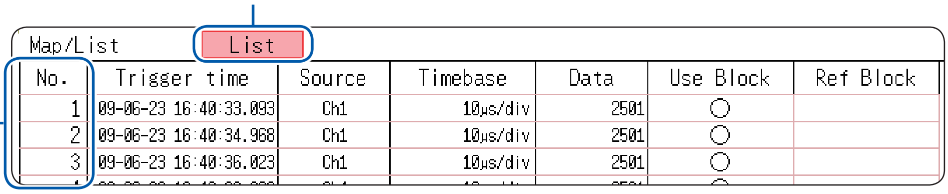
Even if the Roll Mode is enabled (other than **[Off]**), it is not usable when the Trace Waveform display is set to **[Off]**.

To get details on each block

The trigger time and measurement status of each block can be viewed on the list.

Move the cursor to **[Map/List]**, and select **[List]**.

Block No.



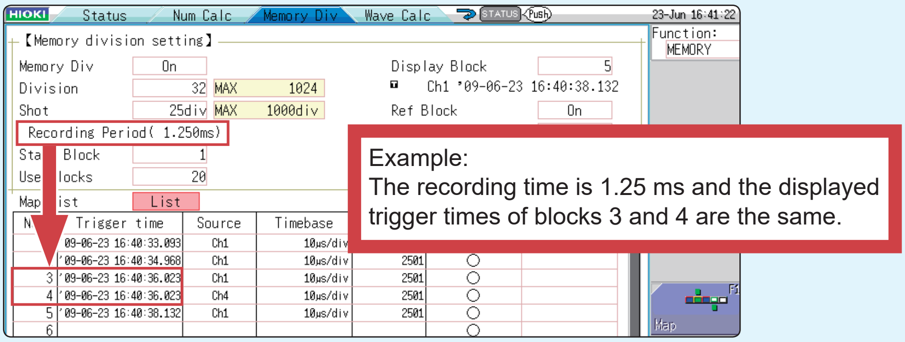
No.	Trigger time	Source	Timebase	Data	Use Block	Ref Block
1	09-06-23 16:40:33.093	Ch1	10µs/div	2501	○	
2	09-06-23 16:40:34.968	Ch1	10µs/div	2501	○	
3	09-06-23 16:40:36.023	Ch1	10µs/div	2501	○	

Blocks can be selected with the **Up/down CURSOR** or **F** keys.
You can move the cursor to the **[Reference Block]** column to set a block as a Reference Block.

To switch block waveforms on the Waveform screen

To select the block you want to see, press the **WAVE** key at the Waveform screen and switch Pos to Block.
Refer to “7.8 View Block Waveforms” (p. 143).

- When displaying memory division blocks as a list, blocks may have the same trigger times. This occurs because the minimum resolution of the clock used by this instrument is 1/128th of a second (7.8125 ms) and measurement occurs during this interval.



【Memory division setting】

Memory Div On
Division 32 MAX 1024
Shot 25div MAX 1000div
Recording Period(1.250ms)
Sta Block 1
Use locks 20
Map ist List
Display Block 5
Ch1 '09-06-23 16:40:38.132
Ref Block On

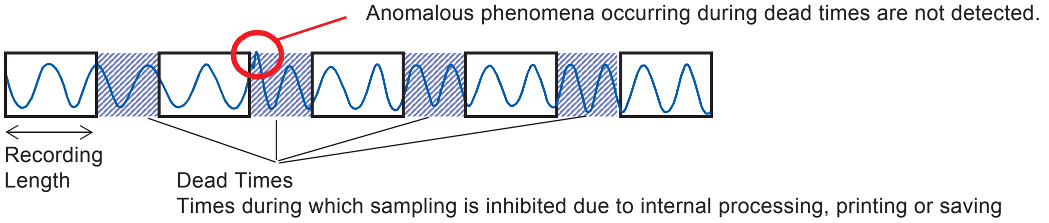
N	Trigger time	Source	Timebase			
	'09-06-23 16:40:33.093	Ch1	10µs/div			
	'09-06-23 16:40:34.968	Ch1	10µs/div	2501	○	
3	'09-06-23 16:40:36.023	Ch1	10µs/div	2501	○	
4	'09-06-23 16:40:36.023	Ch4	10µs/div	2501	○	
5	'09-06-23 16:40:38.132	Ch1	10µs/div	2501	○	
6					○	

Example:
The recording time is 1.25 ms and the displayed trigger times of blocks 3 and 4 are the same.

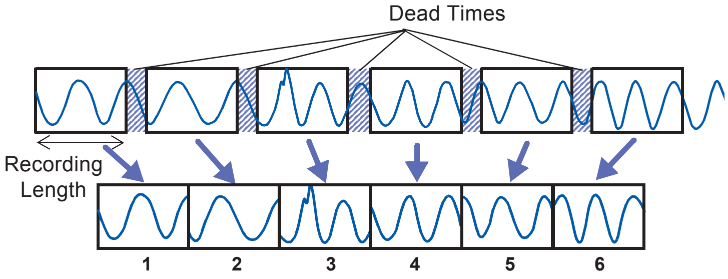
- If triggers occur continuously within an interval shorter than 500 µs, the displayed trigger time may indicate times slower than the actual triggers.

Difference Between Dead Times During Normal and Memory Division Recording

When both printer recording (Auto Print) and Auto Save are set for continuous triggering [Repeat]


Anomalous phenomena occurring during dead times are not detected.
Recording Length
Dead Times
Times during which sampling is inhibited due to internal processing, printing or saving

When the Trace Waveform Display is disabled ([Off]) during Memory Division recording



The waveform data of each recording length is recorded in one block.

When recording with Memory Division, dead time is shorter than with normal recording.

- The dead time (the period where no sampling occurs between blocks) of memory division is as follows.
  5 µs/div to 20 µs/div: 1 to 8 samples
  Timebase slower than 50 µs/div: 1 sample
  Note: Dead time is longer when you use calculation functions or when the timebase is set between 5 and 20 µs/div and tracking waveform display is **[On]**.
- When measuring with an Model 8970 Freq Unit, dead time is approximately 230 ms. When measuring in integral value ([Count]) mode, there are cases when the last data in a previous block is carried over to the first part of the next block.
- When tracking waveform display is **[Off]**, the roll mode function cannot be used, even when roll mode is enabled (not **[Off]**).
- When triggering occurs very often, pressing the **STOP** key may not stop measurement until enough data has been acquired to fill the blocks specified for use.

Auto Save and Auto Print for Memory Division Recording

Measurement conditions	Auto-save and Auto-print
With Numerical calculation ON	Auto-save and Auto-print are performed every time one block is measured. When Tracking wave display is ON, the Waveform is also displayed.
When timebase is 5 µs/div to 20 µs/div and Tracking wave display is ON.	Auto-save, auto-print and Waveform Display are performed every time one block is measured.
When timebase is 5 µs/div to 20 µs/div and Tracking wave display is OFF.	Auto-save and Auto-print are performed after all blocks are measured.
Other than above	Auto-save and Auto-print are performed simultaneously with measurement. When Tracking wave display is ON, the Waveform is also displayed.

13 FFT Function

FFT

13.1 Overview and Features

FFT analysis can only be used with the FFT function.
The FFT (Fast-Fourier Transform) functions perform frequency analysis on input signal data.
Use these functions for frequency analysis of measurement targets such as rotating objects, vibrations, and sounds.
For details, refer to “Appx. 4 FFT Definitions” (p. A13).

Analysis can be performed on data as it is being measured, on pre-existing analog waveform data previously acquired with the Memory function, and on data output from waveform calculations.
When Model 8968 High Resolution Unit or Model U8979 Charge Unit, each of which is equipped with the anti-aliasing filter, is used, the cut-off frequency can be set automatically by linking with the frequency range setting.

Major Features

- FFT analysis frequency range: 133 mHz to 8 MHz
- FFT Analysis Modes (16 types)

  - Storage Waveform
  - Histogram
  - Linear Spectrum
  - RMS Spectrum
  - Power Spectrum
  - Power Spectrum density*
  - LPC analysis (Power Spectrum Density)*
  - Transfer Function
  - Cross Power Spectrum
  - Impulse Response
  - Coherence Function
  - Phase spectrum
  - Auto-correlation Function
  - Cross-correlation Function
  - 1/1 Octave Analysis*
  - 1/3 Octave Analysis*

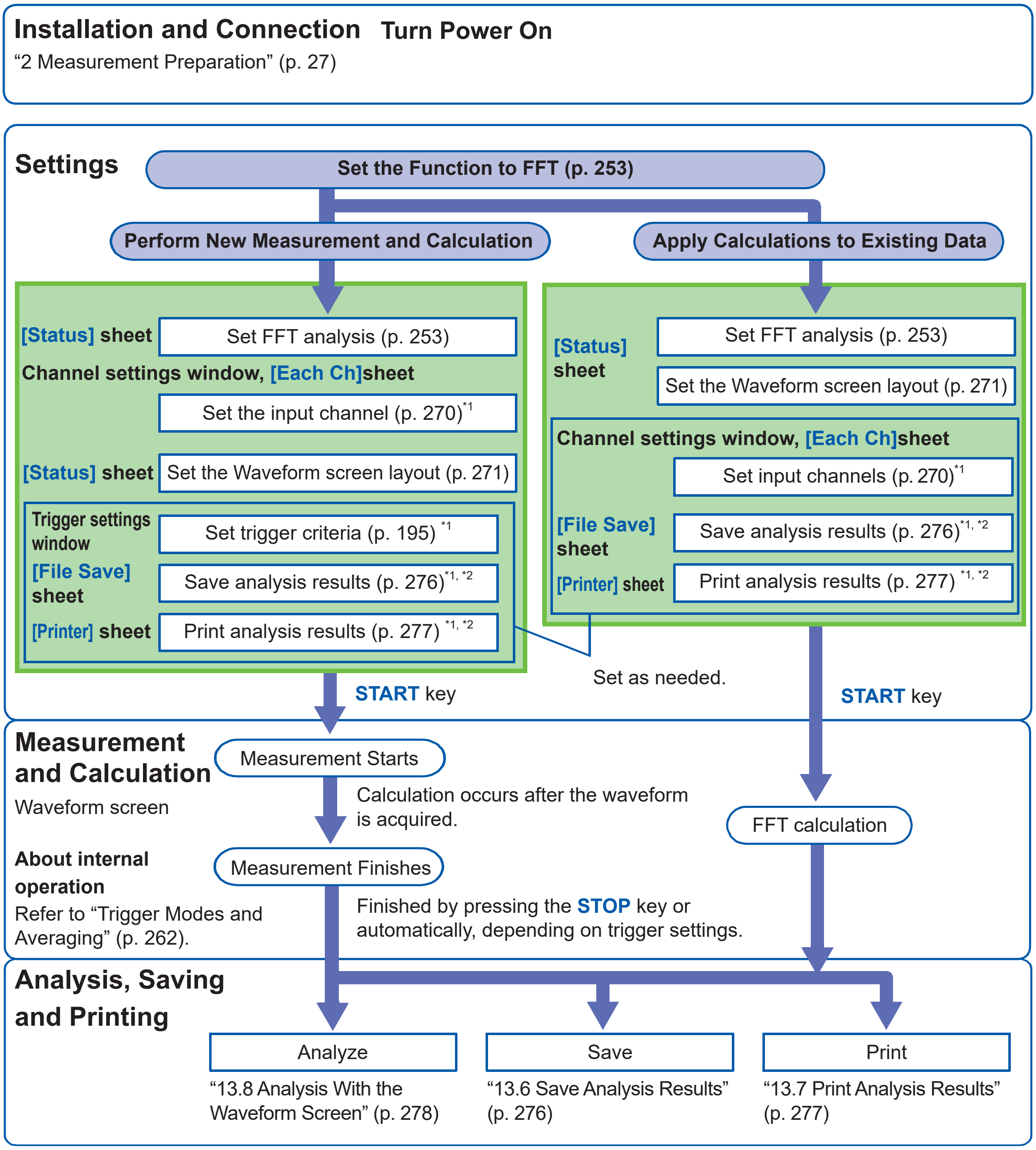
* Not available when using external sampling.

For phase spectra, only the required phase information is highlighted and displayed.
Refer to “13.3.8 Emphasize Analysis Results (Phase Spectra Only)” (p. 263).
When performing FFT analysis with the instrument connected to a sound level or vibration meter, scaling by dB can be set from the Channel Settings screen if you want to read values directly in calibrated units of measurement.
Refer to “Scaling” (p. 270).

To suppress the effects of aliasing distortion caused by sampling
We recommend using Model 8968 High Resolution Units that are equipped with anti-aliasing filtering to suppress the effects of aliasing distortion when sampling.
Refer to “Appx. 4 FFT Definitions” (p. A13).

Refer to “18.3.4 FFT Function” (p. 360) for FFT function specifications.

13.2 Operation Workflow (Reference Data)

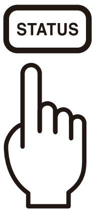

Installation and Connection
Turn Power On
“2 Measurement Preparation” (p. 27)
Settings
Set the Function to FFT (p. 253)
Perform New Measurement and Calculation
Apply Calculations to Existing Data
[Status] sheet
Set FFT analysis (p. 253)
Channel settings window, [Each Ch]sheet
Set the input channel (p. 270)*1
[Status] sheet
Set the Waveform screen layout (p. 271)
Trigger settings window
Set trigger criteria (p. 195) *1
[File Save] sheet
Save analysis results (p. 276)*1, *2
[Printer] sheet
Print analysis results (p. 277) *1, *2
[Status] sheet
Set FFT analysis (p. 253)
Set the Waveform screen layout (p. 271)
Channel settings window, [Each Ch]sheet
Set input channels (p. 270)*1
[File Save] sheet
Save analysis results (p. 276)*1, *2
[Printer] sheet
Print analysis results (p. 277) *1, *2
Set as needed.
START key
START key
Measurement and Calculation
Waveform screen
Measurement Starts
Calculation occurs after the waveform is acquired.
Measurement Finishes
About internal operation
Refer to “Trigger Modes and Averaging” (p. 262).
Finished by pressing the STOP key or automatically, depending on trigger settings.
FFT calculation
Analysis, Saving and Printing
Analyze
“13.8 Analysis With the Waveform Screen” (p. 278)
Save
“13.6 Save Analysis Results” (p. 276)
Print
“13.7 Print Analysis Results” (p. 277)

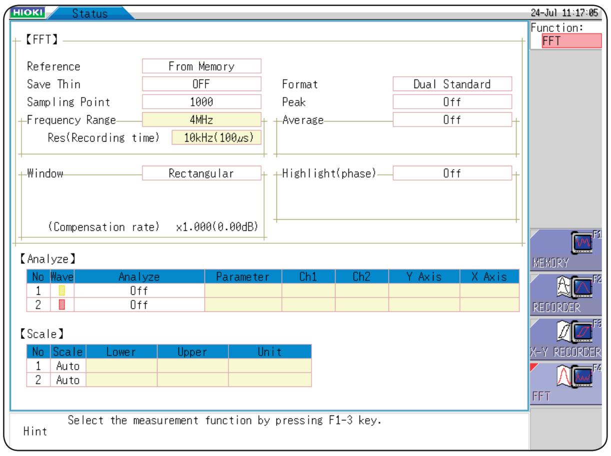
*1: Settings are the same as for the Memory function.
*2: Even after analysis, save and print settings can be set manually.

13.3 FFT Analysis Condition Settings

You can choose basic measurement configuration settings on the Status screen-**[Status]** sheet. Measurement is configured from the Waveform screen (p. 269).

To Open the [Status] Sheet





24-Jul 11:17:05

Function: FFT

【FFT】

Reference: From Memory
Save Thin: OFF
Sampling Point: 1000
Frequency Range: 4MHz
Res(Recording time): 10kHz(100μs)
Format: Dual Standard
Peak: Off
Average: Off
Window: Rectangular
(Compensation rate) x1.000(0.00dB)
Highlight(phase): Off

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

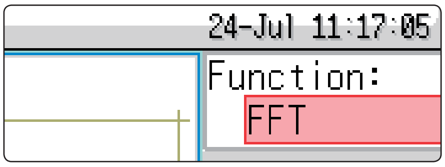
No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

Hint: Select the measurement function by pressing F1-3 key.

13.3.1 Select the FFT Function

The FFT function can be selected at screens other than the file screen.

Procedure



24-Jul 11:17:05

Function: FFT

1 **Move the cursor to the function item (the upper most column of the Settings window).**

2 **Select [FFT].**

13.3.2 Select the Data Source for Analysis (Reference Data)

Select the data to be used for FFT analysis.
There are two analysis methods: analysis using new measurements and analysis of data measured using the memory function.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.
To set from the Waveform screen, refer to (p. 269).

1 **Select the reference data.**

Move the cursor to **[Reference]**.

New Data	Acquire a new waveform for analysis.
From Memory	Calculates data measured using the memory function.

2 **When you have finished choosing settings, press the START key**

When using [New Data]

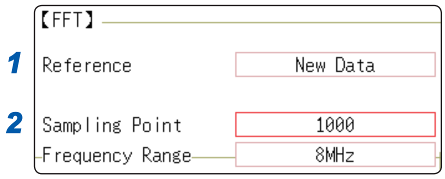
Measurement starts to acquire data for the number of analysis points specified as the **[Sampling Point]**, and FFT analysis is performed.

When using [From Memory]

Analysis is performed on the number of specified points from data previously recorded in memory (Memory function data).

The analysis starting point can also be specified.
Refer to “13.8.1 Analyze After Specifying an Analysis Starting Point” (p. 278).

The frequency range is selected automatically.
Refer to “Relationship Between Frequency Range, Resolution and Number of Analysis Points” (p. 256).



【FFT】

1 Reference New Data

2 Sampling Point 1000

Frequency Range 8MHz

When the input data [Reference] is [From Memory]

Analysis is performed until the specified number of FFT analysis points have been processed, then the data is shifted by that amount and analysis repeats until all of the previously acquired data has been processed. (If the amount of data is less than the specified number of FFT analysis points, no analysis occurs.)

When no trace is displayed after pressing the START key

Analysis is impossible if **[From Memory]** is selected as the input data source and no recorded data exists in the instrument's memory.
Either select **[New Data]** as the input data source, or load the data to be analyzed before pressing the **START** key again.

When **[Reference]** is set to **[From Memory]**, the frequency is automatically set.
The setting cannot be changed.

13.3.3 Set the Frequency Range and Number of Analysis Points

About the Frequency Range and Nnumber of Analysis Points

- The settings for the frequency range and number of analysis points determine the input signal acquisition time and frequency resolution.

- **The frequency range** setting for the FFT function corresponds to the timebase setting of the Memory function.
  Changing the frequency range also changes the data sampling period.
  Refer to “Relationship Between Frequency Range, Resolution and Number of Analysis Points” (p. 256).

- The cut-off frequency of the anti-aliasing filter is the same as the frequency range setting.
  Refer to “Relationship Between Frequency Range, Resolution and Number of Analysis Points” (p. 256).
- The **set number of analysis points** specifies the amount of data to be analyzed with each measurement.
  Increasing the number of analysis points increases the frequency resolution, but also increases the time required for calculations.
  Refer to “Number of Analysis Points” (p. A15).

To perform calculations on external sampling

Set the Sampling Clock to **[External]** (External sampling).
In this case, octave analysis, power spectrum density and LPC Analysis (power spectrum density) are not available.

**When [Reference] is set to [From Memory], the frequency is automatically set.
The setting cannot be changed.**

Frequency Range and Number of Analysis Points Setting: Use the Operating Keys

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.
Refer to “13.3.11 Set and Change Analysis Conditions on the Waveform Screen” (p. 269).

1 **Set the number of FFT analysis points.**

Move the cursor to **[Sampling Point]**.

1000 *(Default setting)*, 2000, 5000, 10000

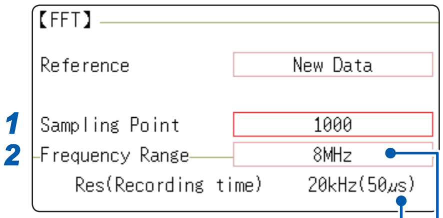
Refer to “Number of Analysis Points” (p. A15).

2 **Select the frequency range.**

Move the cursor to **[Frequency Range]**.

8 MHz *(Default setting)*, 4 MHz, 2 MHz, 800 kHz, 400 kHz, 200 kHz, 80 kHz, 40 kHz, 20 kHz, 8 kHz, 4 kHz, 2 kHz, 800 Hz, 400 Hz, 200 Hz, 80 Hz, 40 Hz, 20 Hz, 8 Hz, 4 Hz, 1.33 Hz, 800 mHz, 667 mHz, 400 mHz, 333 mHz, 133 mHz, External

Refer to “Relationship Between Frequency Range, Resolution and Number of Analysis Points” (p. 256).



【FFT】
Reference New Data
1 Sampling Point 1000
2 Frequency Range 8MHz
Res(Recording time) 20kHz(50µs)

Frequency Resolution (during acquisition)
The resolution is affected by of the selected frequency range and number of analysis points.
Not displayed for external sampling.

To control sampling by an external signal, select **[External]**

When the input data [Reference] is [From Memory]
The frequency range is set automatically when analysis is started.

Relationship Between Frequency Range, Resolution and Number of Analysis Points

Range [Hz]	Sampling frequency [Hz]	Timebase [/div] (MEM)	Sampling period	Number of FFT analysis Points							
				1,000		**2,000**		**5,000**		**10,000**	
				Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval
8 M[*1]	20 M	5 µs	50 ns	20 k	50 µs	10 k	100 µs	4 k	250 µs	2 k	500 µs
4 M[*1]	10 M	10 µs	100 ns	10 k	100 µs	5 k	200 µs	2 k	500 µs	1 k	1 ms
2 M[*1]	5 M	20 µs	200 ns	5 k	200 µs	2.5 k	400 µs	1 k	1 ms	500	2 ms
800 k[*1]	2 M	50 µs	500 ns	2 k	500 µs	1 k	1 ms	400	2.5 ms	200	5 ms
400 k[*1]	1 M	100 µs	1 µs	1 k	1 ms	500	2 ms	200	5 ms	100	10 ms
200 k[*1]	500 k	200 µs	2 µs	500	2 ms	250	4 ms	100	10 ms	50	20 ms
80 k[*1]	200 k	500 µs	5 µs	200	5 ms	100	10 ms	40	25 ms	20	50 ms
40 k	100 k	1 ms	10 µs	100	10 ms	50	20 ms	20	50 ms	10	100 ms
20 k	50 k	2 ms	20 µs	50	20 ms	25	50 ms	10	100 ms	5	200 ms
8 k	20 k	5 ms	50 µs	20	50 ms	10	100 ms	4	250 ms	2	500 ms
4 k	10 k	10 ms	100 µs	10	100 ms	5	200 ms	2	500 ms	1	1 s
2 k	5 k	20 ms	200 µs	5	200 ms	2.5	400 ms	1	250 ms	500 m	2 s
800	2 k	50 ms	500 µs	2	500 ms	1	1 s	400 m	2.5 s	200 m	5 s
400	1 k	100 ms	1 ms	1	1 s	500 m	2 s	200 m	5 s	100 m	10 s
200	500	200 ms	2 ms	500 m	2 s	250 m	4 s	100 m	10 s	50 m	20 s
80	200	500 ms	5 ms	200 m	5 s	100 m	10 s	40 m	25 s	20 m	50 s
40	100	1 s	10 ms	100 m	10 s	50 m	20 s	20 m	50 s	10 m	100 s
20	50	2 s	20 ms	50 m	20 s	25 m	40 s	10 m	100 s	5 m	200 s
8[*2]	20	5 s	50 ms	20 m	50 s	10 m	100 s	4 m	250 s	2 m	500 s
4[*2]	10	10 s	100 ms	10 m	100 s	5 m	200s	2 m	500 s	1 m	1 ks
1.33[*2]	3.33	30 s	300 ms	3.33 m	300 s	1.66 m	600s	666 µ	1.5 ks	333 µ	3 ks
800 m[*2]	2	50 s	500 ms	2 m	500 s	1 m	1 ks	400 µ	2.5 ks	200 µ	5 ks
667 m[*2]	1.67	60 s	600 ms	1.66 m	600 s	833 µ	1.2 ks	333 µ	3 ks	166 µ	6 ks
400 m[*2]	1	100 s	1 s	1 m	1 ks	500 µ	2 ks	200 µ	5 ks	100 µ	10 ks
333 m[*2]	833 m	120 s	1.2 s	833 µ	1.2 ks	416 µ	2.4 ks	166 µ	6 ks	83.3 µ	12 ks
133 m[*2]	333 m	300 s	3 s	333 µ	3 ks	166 µ	6 ks	66.6 µ	15 ks	33.3 µ	30 ks

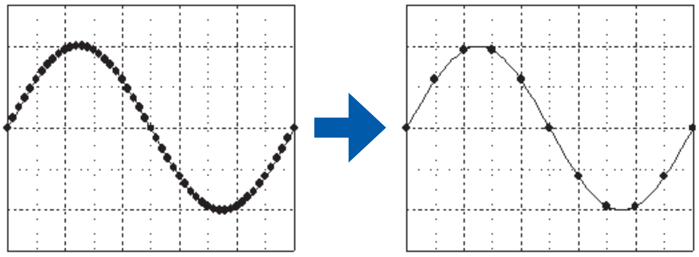
The cut-off frequency of the anti-aliasing filter is the same as the frequency range.

*1. The anti-aliasing filter is off.

*2. Cut-off frequency is 20 Hz.

13.3.4 Thin Out and Calculating Data

When performing FFT analysis of data measured using the memory function, the measurement data can be thinned before calculation.
If the sampling frequency is too high and you get unexpected results, thin the data before calculation to increase the frequency resolution.



Original waveform Thinned waveform

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

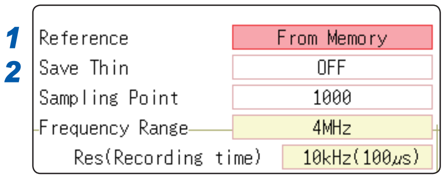
1 Select the reference data.

Move the cursor to **[Reference]**, and select **[From Memory]**.

2 Select the thinning amount.

Move the cursor to **[Save Thin]**.

Off	Do not thin data. *(Default setting)*
1/10	Skip every 10 data points.
1/100	Skip every 100 data points.
1/1000	Skip every 1000 data points.

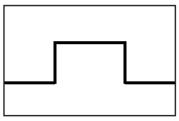


1 Reference From Memory
2 Save Thin OFF
Sampling Point 1000
Frequency Range 4MHz
Res(Recording time) 10kHz(100μs)

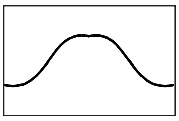
- The **[Save Thin]** setting can only be set when **[Reference]** is set to **[From Memory]**.
- The range that can be set for thinning changes depending on the timebase measured by the memory function.
- The frequency is selected automatically. The setting cannot be changed.
- ***When thinning, aliasing occurs and waveforms that did not originally exist may be observed. Make settings after sufficient consideration of the frequencies included in waveforms.***

13.3.5 Window Function Settings

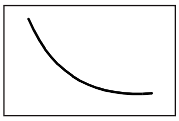
The window function defines the segment of the input signal to be analyzed.
Use the window function to minimize leakage errors (p. A20).
There are three general types of window functions:



- Rectangular Window



- Hann window
- Hamming window
- Blackman window
- Blackman-Harris window
- Flat top window

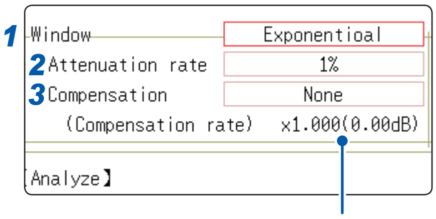


- Exponential window

The non-rectangular window functions generally produce lower-level analysis results. The attenuation introduced by the non-rectangular window functions can be corrected by applying attenuation correction to bring analysis results back levels similar to those of a rectangular window.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.
To set from the Waveform screen, refer to (p. 269).



1 Window Exponentioal
2 Attenuation rate 1%
3 Compensation None
(Compensation rate) x1.000(0.00dB)
Analyze

Correction value

1 **Select the window function.**

Move the cursor to **[Window]**.

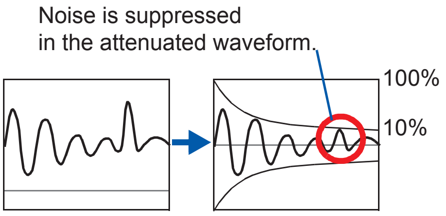
Rectangular *(Default setting)*, Hanning, Exponential, Hamming, Blackman, Blackman Harris, Flat-top, Exponential

Refer to “Window Function” (p. A20).

2 **When [Exponential] is selected**

Set the attenuation coefficient (percentage).

Move the cursor to **[Attenuation rate]**.
Set the attenuation coefficient as a percentage.



3 **Set attenuation correction.**

Move the cursor to **[Compensation]**.

None	Attenuated window function values are not corrected. *(Default setting)*
Power	The window function multiplies the power levels of the time-domain waveform so that output levels are comparable to those of a rectangular window.
Average	The window function multiplies the average value of the time-domain waveform so that output levels are comparable to those of a rectangular window.

For the rectangular window function, the correction value is always 1 (0 dB).

13.3.6 Analysis Result Peak Value Settings

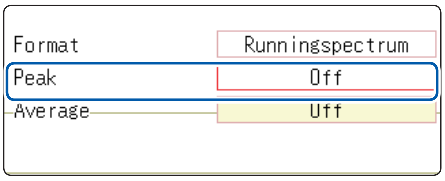
You can display local or global maxima ([maximal]/ [maximum]) of the input signal and analysis results on the Waveform screen. However, if Nyquist display is selected on the Status screen-**[Status]** sheet, no peak values are displayed.

Procedure

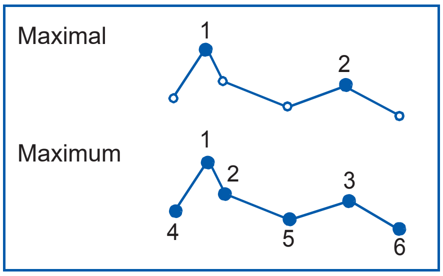
Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

To select peak value display.
Move the cursor to **[Peak]**.

Off	Not displayed. *(Default setting)*
Maximal	(local maxima) When the value of data at a point is greater than that of the adjacent points, that point is considered a local maximum. The ten largest local maxima are displayed.
Maximum	(global maxima) Among all data values, the ten points with the greatest values are displayed.

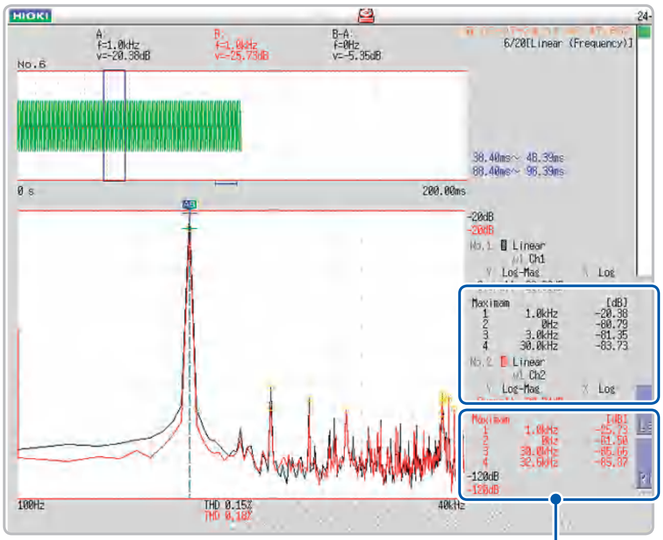


Format Runningspectrum
Peak Off
Average Off



- No maxima will be displayed if peak values cannot be detected.
- Peak values on the Waveform screen can be displayed and printed, but cannot be saved as peak values in text files.
- Depending on the split screen status, it may not be possible to display ten peak values. In such cases, as many items as possible will be displayed, starting from the largest item.

Example: When the reference data setting is **[From Memory]**



```
Maximam              [dB]
  1      1.0kHz    -20.38
  2         0Hz    -80.79
  3      3.0kHz    -81.35
  4     30.0kHz    -83.73
```

```
Maximam              [dB]
  1      1.0kHz    -25.73
  2         0Hz    -61.50
  3     30.0kHz    -85.66
  4     32.6kHz    -85.87
```

Peak value display
From 1 to 4

13.3.7 Average Analysis Results (Waveform Averaging)

The averaging function calculates the average of the values obtained from multiple measurements of a periodic waveform.
This can reduce noise and other non-periodic signal components. Averaging can be applied to a time-domain waveform or to a spectrum.

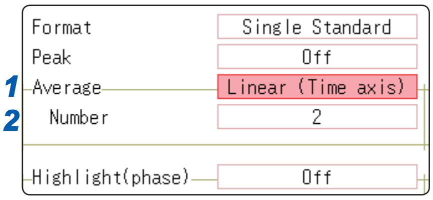
Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

1 **Enable averaging.**

Move the cursor to **[Average]**.

Off	Averaging is disabled. *(Default setting)*
Linear (Time axis)	Time-domain waveforms are summed and averaged and then calculation is performed.
Expo. (Time axis)	The exponential mean of time-domain waveforms is determined and then calculation is performed.
Linear (Frequency)	Frequency-domain waveforms are summed and averaged and then the calculation result is output.
Expo. (Frequency)	The exponential mean of frequency-domain waveforms is determined and then the calculation result is output.
Peak (Frequency)	The maximum value of frequency-domain waveforms is retained.



Format Single Standard
Peak Off
Average Linear (Time axis)
Number 2
Highlight(phase) Off

About averaging calculation formulas

Refer to “Averaging” (p. A19).

When averaging and auto-saving or auto-printing are enabled at the same time

Data is saved or printed after the specified number of values has been averaged.

2 **Select the count for averaging.**

Move the cursor to **[Number]**.
Select the number of measurements to be averaged.
Setting range: 2 to 10,000

Refer to “Trigger Modes and Averaging” (p. 262).

- After measuring with averaging enabled, display is not available when the channel is changed. Also, when the analysis mode is changed, the analysis modes that can be displayed are limited.
- When averaging is performed with analysis mode disabled (Off), no trace will be displayed when the analysis mode is changed after measurement.
- When **[Format]** is set to **[Running spectrum]**, **[Average]** cannot be used.

To average time-domain waveform values

Waveforms are acquired and averaged within the time domain. FFT calculation is performed after averaging.
When the trigger mode is **[Auto]**: When the **START** key is pressed, data will be acquired after a certain interval even if trigger criteria are not met. This means that if averaging is applied to an asynchronous signal, the resulting data is meaningless.
Synchronous signals have better SNR (signal-to-noise ratio) and are more suitable for analysis.

To average spectrum values

Acquired data is first subject to FFT analysis. After analysis, averaging is performed within the frequency range, and the result is displayed. This differs from time-domain averaging in that averaging can be performed without trigger synchronization. However, if the characteristics of the input waveform allow triggering, using the trigger for synchronization is recommended.

To retain peak value on spectrum (peak hold)

After performing FFT calculations on the acquired waveform, peak values are retained (held) and displayed within the frequency range.

■ FFT Analysis Modes and Averaging

✓: Can be set, —: Cannot be set, ○: Can be partially set

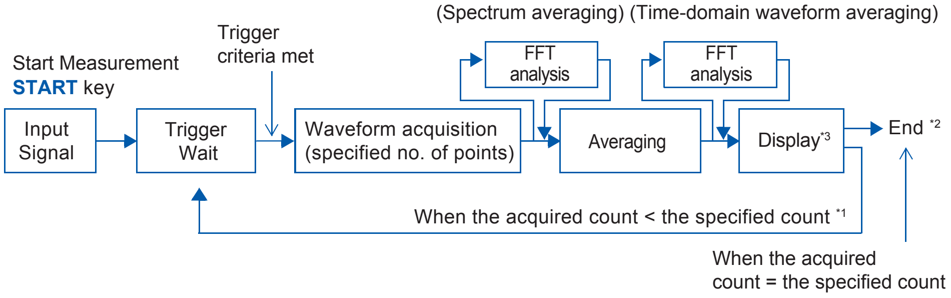
Analysis mode	Averaging				
	Time-domain waveform averaging		Spectrum averaging		
	Simple	Exponential	Simple	Exponential	Peak hold
OFF	—	—	—	—	—
Storage Waveform	✓	✓	—	—	—
Histogram	✓	✓	—	—	—
Linear Spectrum	✓	✓	○*2	○*2	○*2
RMS Spectrum	✓	✓	○*2	○*2	○*2
Power Spectrum	✓	✓	✓	✓	✓
Power Spectrum Density *1	✓	✓	✓	✓	✓
LPC analysis (Power Spectrum Density) *1	✓	✓	—	—	—
Transfer Function	✓	✓	○*2	○*2	○*2
Cross Power Spectrum	✓	✓	○*2	○*2	○*2
Impulse Response	✓	✓	✓	✓	✓
Coherence Function	—	—	✓	✓	—
Phase spectrum	✓	✓	—	—	—
Auto-correlation Function	✓	✓	✓	✓	✓
Cross-correlation Function	✓	✓	✓	✓	✓
1/1 Octave Analysis *1	✓	✓	✓	✓	✓
1/3 Octave Analysis *1	✓	✓	✓	✓	✓

*1. Not available for external sampling
*2. Not available when the y axis is real (linear) or imaginary (linear), and for Nyquist plots

■ Trigger Modes and Averaging

If the trigger mode is [Single] or the calculation setting is [Once]

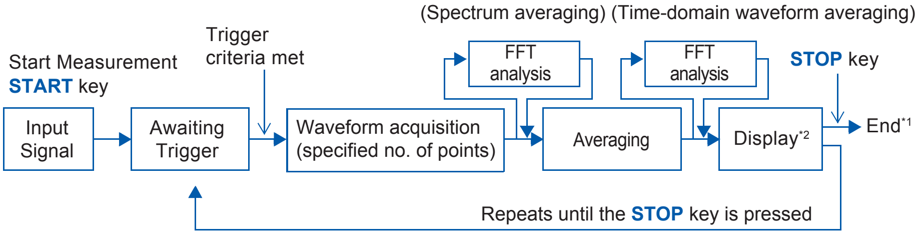
Measurement continues until the specified number of averaging points is acquired


(Spectrum averaging) (Time-domain waveform averaging)
Start Measurement
START key
Trigger
criteria met
FFT analysis
FFT analysis
Input Signal
Trigger Wait
Waveform acquisition (specified no. of points)
Averaging
Display*3
End *2
When the acquired count < the specified count *1
When the acquired count = the specified count

*1. Awaiting trigger continues until the specified count is reached.
*2. Measurement stops automatically when the specified count is reached. If measurement was interrupted by the **STOP** key, the averaging result up to that point is displayed.
*3. If **[Reference]** is **[New Data]** and automatic saving or automatic print is **[On]**, data is saved or printed when the specified number of times is reached.

If the trigger mode is [Continue] or the calculation setting is [Repeat]

Measurement continues after the specified averaging count has been acquired.
When the specified averaging count is exceeded, averaging is repeated and measurement continues until the **STOP** key is pressed.

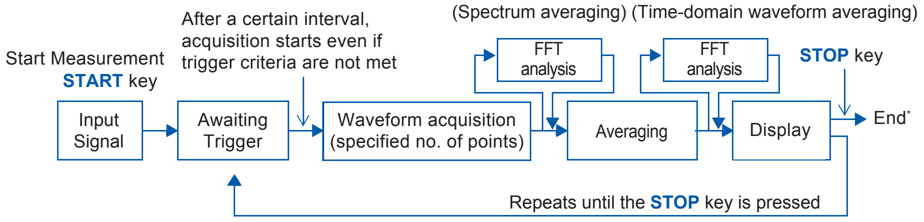

(Spectrum averaging) (Time-domain waveform averaging)
Start Measurement
START key
Trigger
criteria met
FFT analysis
FFT analysis
STOP key
Input Signal
Awaiting Trigger
Waveform acquisition (specified no. of points)
Averaging
Display*2
End*1
Repeats until the STOP key is pressed

*1. When stopped before the specified count, the average up to that point is displayed.
*2. If **[Reference]** is **[New Data]** and automatic saving or automatic print is **[On]**, data is saved or printed when the specified number of times is reached.

When the trigger mode is [Auto]

- For time-domain waveforms
  When the **START** key is pressed, after a certain interval data will be acquired even if trigger criteria are not met. This means that if averaging is applied to an asynchronous signal, the resulting data is meaningless.

- For time-domain waveforms
  When the **START** key is pressed, measurement starts. Even if the trigger criteria are not met, the specified amount of data is acquired, and after FFT analysis, the results are averaged.
  When the specified averaging count is exceeded, averaging is repeated and measurement continues until the **STOP** key is pressed.

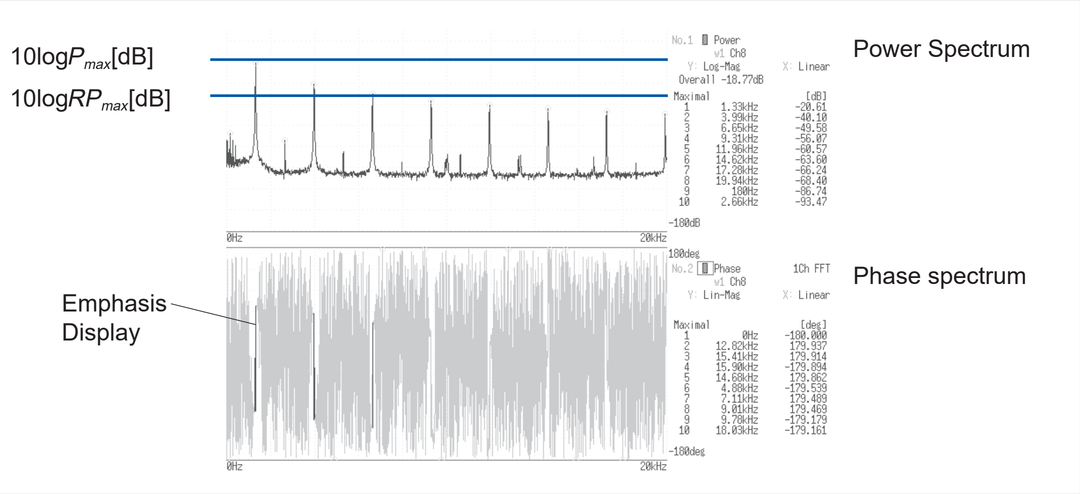

(Spectrum averaging) (Time-domain waveform averaging)
Start Measurement
START key
After a certain interval,
acquisition starts even if
trigger criteria are not met
FFT analysis
FFT analysis
STOP key
Input Signal
Awaiting Trigger
Waveform acquisition (specified no. of points)
Averaging
Display
End*
Repeats until the STOP key is pressed

* When stopped before the specified count, the average up to that point is displayed.

13.3.8 Emphasize Analysis Results (Phase Spectra Only)

By specifying a setting factor (rate) to be applied to the input signal, the display of data that exceeds the resulting threshold can be emphasized. This feature is useful for viewing waveforms that may otherwise be obscured by noise.

The reliability of phase spectrum values is poor when discrete Fourier transform values are extremely small. For example, in the case of a pure sine wave, almost all phase values at frequencies other than the input frequency result from calculation errors. By treating the maximum value of the power (or cross-power) spectrum of the input signal, P_{max}, as a reference value, data that exceeds that value multiplied by rate R can be displayed with emphasis.



```
No.1 ▓ Power
      w1 Ch8
  Y: Log-Mag          X: Linear
 Overall -18.77dB
Maximal                    [dB]
  1      1.33kHz         -20.61
  2      3.99kHz         -40.10
  3      6.65kHz         -49.58
  4      9.31kHz         -56.07
  5     11.96kHz         -60.57
  6     14.62kHz         -63.60
  7     17.28kHz         -66.24
  8     19.94kHz         -68.40
  9        180Hz         -86.74
 10      2.66kHz         -93.47
```

```
No.2 ▓ Phase           1Ch FFT
      w1 Ch8
  Y: Lin-Mag          X: Linear

Maximal                   [deg]
  1          0Hz       -180.000
  2     12.82kHz        179.937
  3     15.41kHz        179.914
  4     15.90kHz       -179.894
  5     14.68kHz        179.862
  6      4.88kHz       -179.539
  7      7.11kHz        179.489
  8      9.01kHz        179.469
  9      9.78kHz       -179.179
 10     18.03kHz       -179.161
```

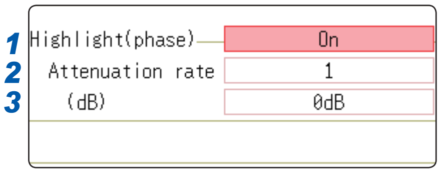
Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

1 **Enable the highlighting function.**

Move the cursor to **[Highlight (phase)]**.

Off	Emphasis display disabled. *(Default setting)*
On	Emphasis display enabled.



1 Highlight(phase) On
2 Attenuation rate 1
3 (dB) 0dB

2 **Set the attenuation rate or attenuation value.**

To set an attenuation rate

Move the cursor to **[Attenuation rate]**.
Enter the attenuation rate.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

To set an attenuation value [dB]

Move the cursor to **[(db)]**.
Enter the attenuation value.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

Attenuation Rate and Value

Attenuation value: A [dB]
Attenuation rate: R

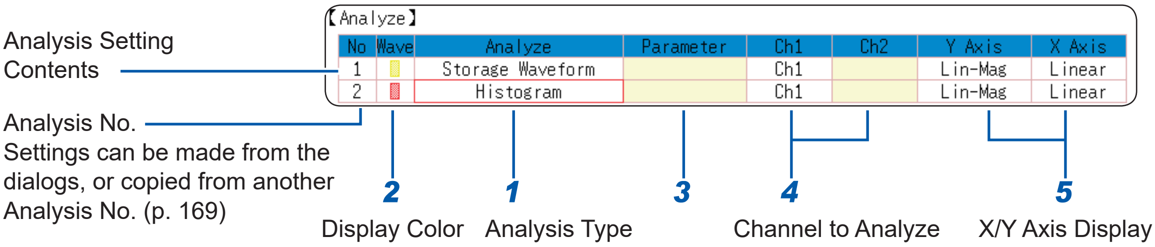
$-A = 10\log_{10}R$
$1 \times 10^{-6} \leq R \leq 1$
$0 \leq A \leq 60$

13.3.9 Analysis Mode Settings

You can set the type of FFT analysis, channel(s), waveform display color and X and Y axes.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.
To set from the Waveform screen, refer to (p. 269).



【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Storage Waveform		Ch1		Lin-Mag	Linear
2	🟥	Histogram		Ch1		Lin-Mag	Linear

Settings can be made from the dialogs, or copied from another Analysis No. (p. 169)

1 **Select the FFT analysis mode.**

Move the cursor to the **[Analyze]** column of the Analysis No. you wish to set.

Off	No analysis *(Default setting)*	Cross Power Spectrum	(p. 287)
Storage Waveform	(p. 280)	Impulse Response	(p. 288)
Histogram	(p. 280)	Coherence Function	(p. 289)
Linear Spectrum	(p. 281)	Phase spectrum	(p. 290)
RMS Spectrum	(p. 282)	Auto-correlation	(p. 291)
Power Spectrum	(p. 283)	Cross-correlation	(p. 292)
Power Spectrum density*	(p. 284)	1/1 Octave*	(p. 292)
LPC (density)*	(p. 285)	1/3 Octave*	(p. 292)
Transfer Function	(p. 286)		

*Not available with external sampling enabled.
Refer to “13.9.2 Analysis Mode Functions”
(p. 297).

(When **[List]** is selected, a list of calculation types appears. To clear the display, press the **CH.SET** key.)

2 **Select whether the waveform will be displayed and its color.**

Move the cursor to the **[Wave]** column.
Select whether to be display (On) the waveform or not, and its color if displayed.

3 When [Parameter] setting contents are displayed

Set the parameter.

Move the cursor to the **[Parameter]** column of the Analysis No. you want to set.

Analyze	Parameter	Settings
1/1 Octave, 1/3 Octave	Filter: Normal	Set the octave filter. Refer to “Octave Filter Settings” (p. 266).
	Filter: Sharp	
Phase Spectrum	1ch FFT	Calculates the phase of **[Ch1]**.
	2ch FFT	Calculates the phase difference between **[Ch1]** and **[Ch2]**.
LPC (density)	Order: 2 to 64	Larger numerical values make finer spectrum components visible.

4 Select the channel for analysis.

Move the cursor to **[Ch1]**.
Select which channel number to use.

5 Set the horizontal and vertical axes displaying the calculation results.

Move the cursor to the **[X Axis]** or **[Y Axis]**.
Set the contents of the calculation results to be displayed on the horizontal and vertical axes.
(Selectable display contents vary by analysis mode.)
Refer to “Analysis Modes and X/Y Axis Display” (p. 266).

Analysis channel setting
For the following analysis modes, set both channels 1 and 2.
Transfer Function, Impulse Response, Cross-correlation Function, Cross Power Spectrum, Coherence Function, Phase Spectrum (2ch FFT)

Y-axis display

Lin-Mag	Display analysis results as amplitude values.
Log-Mag	Display analysis results as dB values. The dB reference is 1 eu. Example: For voltage, 1 V is displayed as 0 dB.
Lin-Real	Display the real-number component of analysis values.
Lin-Imag	Display the imaginary component of analysis values.

To analyze using external sampling
The horizontal axis (x-axis) displays the number of data points.

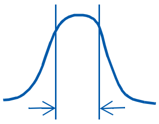
X-axis display

Linear	Frequency-axis is displayed linearly.
Log	Frequency-axis is displayed logarithmically. This is convenient when the data of interest is at the lower end of the frequency range, such as when measuring sound and vibration.

To copy settings to another calculation No.?
Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

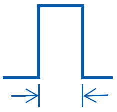
■ Octave Filter Settings

Filter features are based on JIS C1513-2002 class 1, class 2 (IEC61260).



Normal

Filter characteristics approximate those of an analog filter.



Sharp

Only those spectral component within the octave band are used for analysis. Spectral components outside of the octave band are totally ignored.

After determining the entire power spectrum, the instrument performs octave analysis defined by the above filter characteristics.
Refer to “Octave Filter Characteristics” (p. A24).

Analysis Modes and X/Y Axis Display

✓: Settable, —: Unsettable

Analysis mode	X axis		Y axis				Nyquist display
	Linear	Log	Lin-Mag	Lin-Mag	Lin-Real	Lin-Imag	
OFF	—	—	—	—	—	—	—
Storage Waveform	✓	—	✓	—	—	—	—
Histogram	✓	—	✓	—	—	—	—
Linear Spectrum	✓	✓	✓	✓	✓	✓	✓
RMS Spectrum	✓	✓	✓	✓	✓	✓	—
Power Spectrum	✓	✓	✓	✓	—	—	—
Power Spectrum Density	✓	✓	✓	✓	—	—	—
LPC Analysis (Power Spectrum Density)	✓	✓	✓	✓	—	—	—
Transfer Function	✓	✓	✓	✓	✓	✓	✓
Cross Power Spectrum	✓	✓	✓	✓	✓	✓	✓
Impulse Response	✓	—	✓	—	—	—	—
Coherence Function	✓	✓	✓	—	—	—	—
Phase Spectrum	✓	✓	✓	—	—	—	—
Auto-correlation Function	✓	—	✓	—	—	—	—
Cross-correlation Function	✓	—	✓	—	—	—	—
1/1 Octave	—	✓	✓	✓	—	—	—
1/3 Octave	—	✓	✓	✓	—	—	—

The X/Y axes cannot be set when Nyquist Display is selected.

■ Total Harmonic Distortion (THD)

When the analysis mode is linear spectrum, RMS spectrum or power spectrum the cursor appears and the distortion rate is calculated.
(Linear spectrum, RMS spectrum, power spectrum)
The distortion rate calculates the cursor position as the fundamental wave. When 2 cursors appear, the A cursor becomes the fundamental wave.
When calculation results cannot be obtained, **[---%]** is displayed.
Note that distortion rate values may become higher depending on the window function settings.

$$\mathrm{THD} = \sqrt{\frac{\sum (V_n)^2}{(V_0)}} \times 100 \ [\%]$$

V_0 =fundamental wave

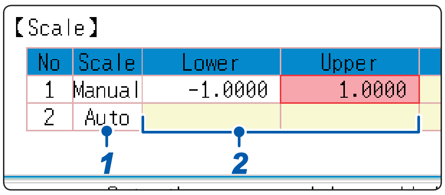
V_n =next higher harmonic

13.3.10 Set the Display Range of the Vertical Axis (Scaling)

The display range of the vertical (Y) axis can be set to automatically fir analysis results and can be freely expanded and compressed.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.



【Scale】

No	Scale	Lower	Upper
1	Manual	-1.0000	1.0000
2	Auto		

1 **Select automatic or manual scaling of the Y-axis display.**

Move the cursor to the **[Scale]** column of the Analysis No. you want to set.

Auto	Scaling of the vertical (Y) axis is automatically set according to analysis results. *(Default setting)*
Manual	Scaling of the vertical (Y) axis can be set as desired, to suit the measurement. This is useful for magnifying or reducing the displayed amplitude, and for shifting the displayed waveform up or down.

2 **When [Manual] is selected**

Set the upper and lower limits.

Move the cursor to **[Lower]** or **[Upper]**.
Set the upper and lower limits to display the analysis results.
Setting range: −9.9999E+29 to +9.9999E+29
(with exponent from E−29 to E+29)

Refer to “8.1.3 Alphanumeric Input” (p. 149).

To copy settings to another calculation No.

Refer to “8.9 Copy Settings to Other Channels (Copy Function)” (p. 169).

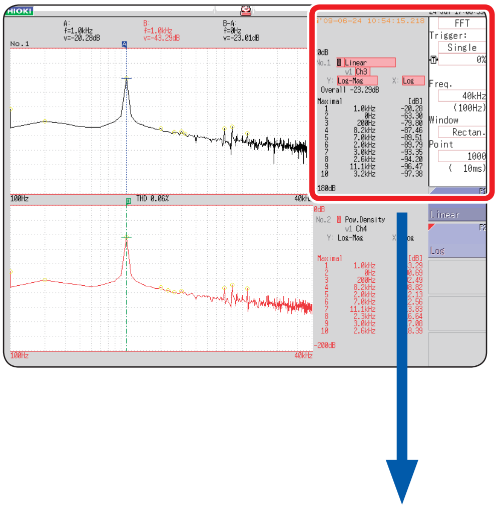
13.3.11 Set and Change Analysis Conditions on the Waveform Screen

The following settings can be made on the Waveform screen.
Changes to the displayed analysis results take effect when the settings are changed.

- Available settings are frequency range, number of analysis points, type of window function, trigger mode and pre-triggering
- Available display type settings are analysis number, analysis mode, waveform color, analysis channel and X/Y axis
- Trigger settings (p. 198)
  (Note: If **[Reference]** is **[From Memory]**, triggers cannot be set.)

Setting Descriptions

Press the **DISP** key to open the Waveform screen.

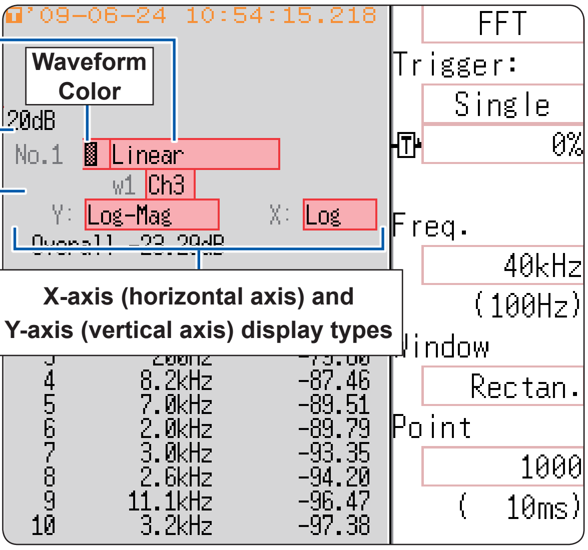


Setting method

Use the CURSOR keys to move the cursor to each setting item, and select options the F keys.

Trigger mode and Pre-trigger

Select the trigger mode and pre-triggering (same as when using the Memory function).
Trigger Mode: Single, Repeat, Auto
Pre-trigger: Select from list
Refer to “9.2 Set the Trigger Mode” (p. 197).
Refer to “9.8 Pre-trigger Settings” (p. 209).



```
'09-06-24 10:54:15.218     FFT
                           Trigger:
                             Single
20dB                       0%
No.1  Linear
   w1 Ch3
  Y: Log-Mag      X: Log   Freq.
Overall  -23.29dB            40kHz
                           (100Hz)
                           Window
 4    8.2kHz    -87.46       Rectan.
 5    7.0kHz    -89.51     Point
 6    2.0kHz    -89.79        1000
 7    3.0kHz    -93.35     (  10ms)
 8    2.6kHz    -94.20
 9   11.1kHz    -96.47
10    3.2kHz    -97.38
```

Analysis Mode

Waveform Color

Analysis Number* **(p. 264)**

Analysis Channel

* Coupled with the **[Analysis]** list on the **[Status]** sheet of the Status screen.

X-axis (horizontal axis) and Y-axis (vertical axis) display types

Select the frequency range (133 mHz to 8 MHz). (p. 255)

Frequency Resolution (during acquisition)

FFT Window Function Type (p. 258)

Number of Analysis Points (p. 255)
(1000, 2000, 5000, 10000)

13.4 Select Channels

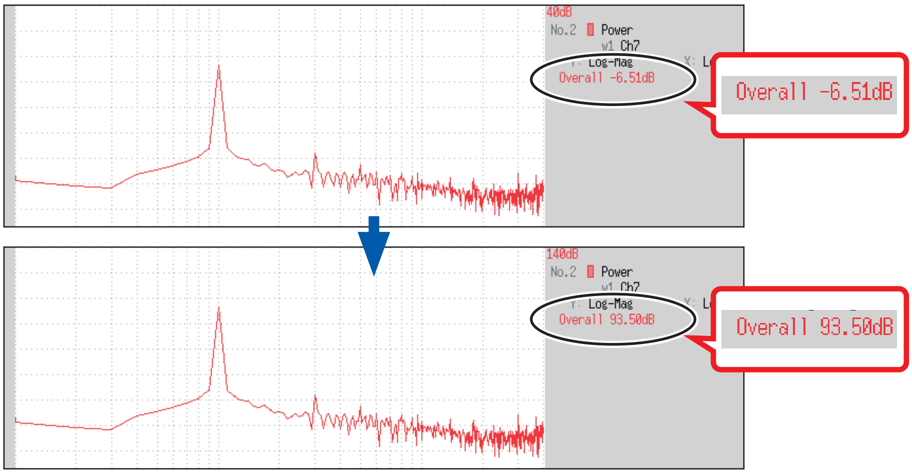
Channel selection is the same for all functions.
For the setting method, refer to “3.4 Select Input Channels” (p. 66) and “8.10 Detailed Settings for Modules” (p. 170).

Scaling

The scaling setting allows values displayed on the instrument to match the actual values read directly on a sound level meter or vibration meter.

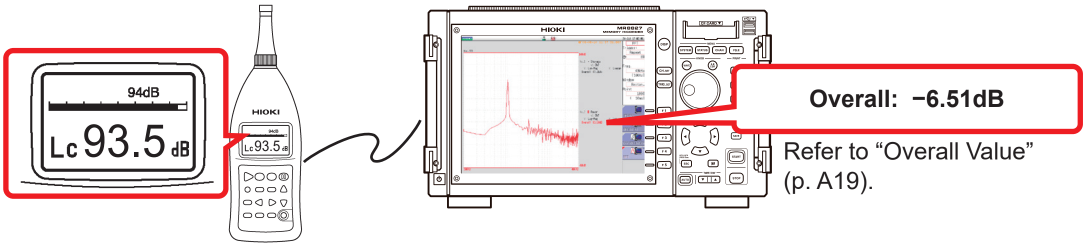
Without Scaling

With Scaling



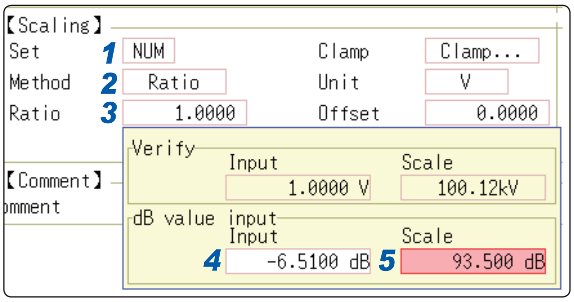
Setting example: To display measurement data on the instrument so that it corresponds with a sound level meter.

In this case the sound level meter displays 93.5 dB and the overall value displayed on the Waveform screen of the instrument is –6.51 dB.



Refer to “Overall Value” (p. A19).

Sound Level Meter



【Scaling】
Set 1 NUM
Method 2 Ratio
Ratio 3 1.0000
Clamp Clamp...
Unit V
Offset 0.0000
Verify
Input 1.0000 V
Scale 100.12kV
【Comment】
omment
dB value input
Input 4 -6.5100 dB
Scale 5 93.500 dB

0 dB reference differs depends on the physical quantity.
As an example for sound pressure, 20 µPa is 0 dB.
In dB scaling, the dB value can be directly read; however, it may not be possible to directly read instantaneous values.
Refer to written standards and other materials regarding 0 dB references.

1. **Select [Num].**
2. **Select [Ratio].**
3. **Move the cursor to [Ratio], and press the F1 [dB Scaling] key.**
   The dB Scaling dialog appears.
4. **Enter the (overall) value “−6.51” displayed on the instrument.**
5. **Enter the value “93.5” (from the sound level meter) that you want to read directly.**
6. **Press the F5 [Confirm] key to perform scaling.**
   Scaling will be performed automatically and the conversion value set in the conversion rate column.

13.5 Screen Display Settings

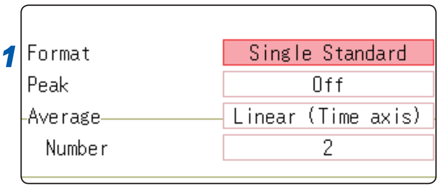
Set the display method for FFT calculation results.

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

1 **Select the display format.**

Move the cursor to **[Format]**.
Select the format of data to be displayed.
The display format depends on the input data selected for analysis.



1 Format: Single Standard
Peak: Off
Average: Linear (Time axis)
Number: 2

Single Standard	The FFT calculation results are displayed in one screen. If the calculations have multiple settings, waveforms will be overlaid. Note: Depending on the analysis mode settings, only analysis No1 may be displayed.
Dual Standard	The FFT calculation results are displayed in two screens. If the calculations have multiple settings, waveforms are displayed for each specified calculation.
Single Nyquist*	If the analysis mode is linear spectrum, transfer function or cross power spectrum, the FFT calculation result is displayed in a Nyquist display on two screens. If the calculations have multiple settings, waveforms will be overlaid.
Dual Nyquist*	If the analysis mode is linear spectrum, transfer function or cross power spectrum, the FFT calculation result is displayed in a Nyquist display on one screen. If the calculations have multiple settings, waveforms are displayed for each specified calculation.
Running spectrum	If the analysis mode is one of the following, analysis results will be displayed in three-dimensions: frequency, oscillation and time. (Linear spectrum, RMS spectrum, power spectrum, power spectrum density, LPC analysis, transfer function, cross power spectrum, 1/1 octave analysis, 1/3 octave analysis) If the calculations have multiple settings, display of No1 will take priority.

* The horizontal axis and vertical axis display the real parts and the imaginary parts of calculation results, respectively.

2 **Press the DISP key to display the Waveform screen.**

To use an existing memory waveform for analysis

Select **[From Memory]** as the input data source for **[Reference]**.
Refer to “13.3.2 Select the Data Source for Analysis (Reference Data)” (p. 254).

To specify the analysis starting point

Specify the starting point on the memory waveform.
Refer to “13.8.1 Analyze After Specifying an Analysis Starting Point” (p. 278).

When “Drawing failed” is displayed

- **NG: Nyquist, Running Spectrum**
  The display format settings and analysis mode do not match.

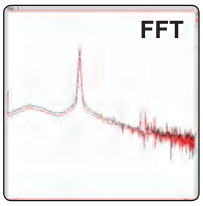
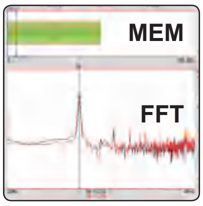
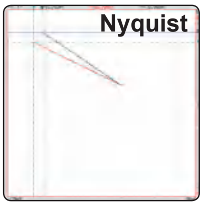
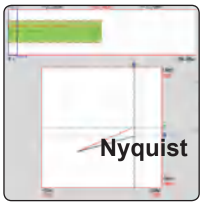
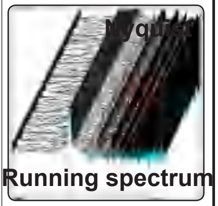
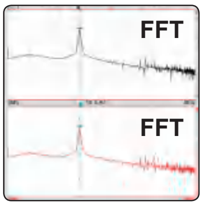
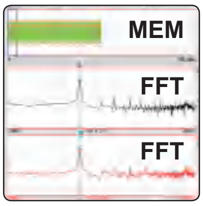
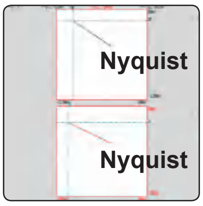
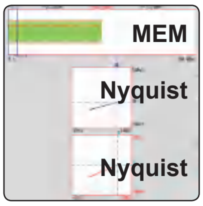
- **NG: X-Axis**
  Either change the **[Format]** setting and increase the number of screen divisions or change the display setting of the X-axis.
  Linear and logarithmic X-axes cannot be displayed on the same graph.

- **NG: X-unit**
  Set **[Format]** and increase the number of screen divisions. Different horizontal axis units cannot be displayed on the same graph.

- **NG: EXT**
  Analysis mode cannot perform external sampling.

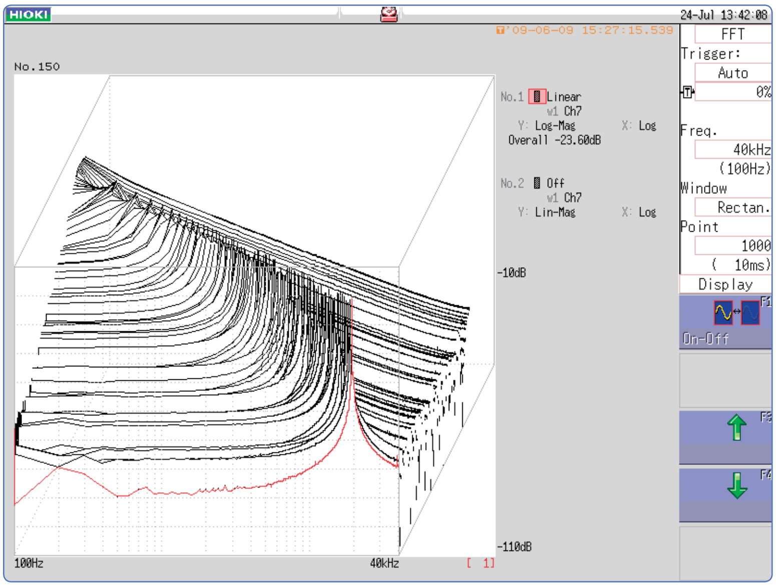
Display Types and Split-Screen Settings

Nine display arrangements are available.

	Standard		Nyquist		Running Spectrum
	Single standard	Dual standard	Single Nyquist	Dual Nyquist	Running spectrum
[Reference] setting	**[New Data]**	**[From Memory]**	**[New Data]**	**[From Memory]**	**[New Data]**
One division					
Two divisions					

13.5.1 Display Running Spectrums

If **[Format]** is set to **[Running spectrum]**, you can observe changes in frequency over time.



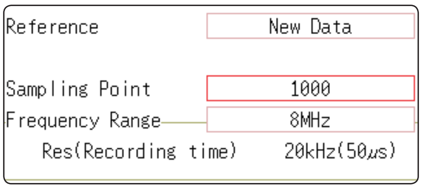
FFT
Trigger: Auto
0%
Freq. 40kHz (100Hz)
Window Rectan.
Point 1000 (10ms)
Display

Procedure

Press the **STATUS** key to open the Status screen, and then select the **[Status]** sheet.

1 **Select the reference data.**

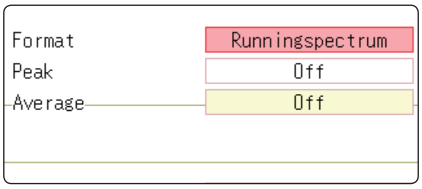
Move the cursor to **[Reference]**, and select **[New Data]**.



Reference New Data
Sampling Point 1000
Frequency Range 8MHz
Res(Recording time) 20kHz(50µs)

2 **Select the display format.**

Move the cursor to **[Format]**, and select **[Running spectrum]**.



Format Runningspectrum
Peak Off
Average Off

- **[Running spectrum]** can only be set when **[Reference]** is **[New Data]**.
- The calculation interval (time interval of the running spectrum waveform and the waveform) is not regulated.
- Averaging cannot be used.
- Calculations that can be analyzed by running spectrum are limited to the following list. When other calculations are selected or calculation settings are changed after measurement stops, waveforms will not be displayed.
  (Linear spectrum, RMS spectrum, power spectrum, power spectrum density, LPC analysis, transfer function, cross power spectrum, 1/1 octave analysis, 1/3 octave analysis)
- When running spectrum is displayed, the auto-saving/auto-printing during measurement cannot be performed.

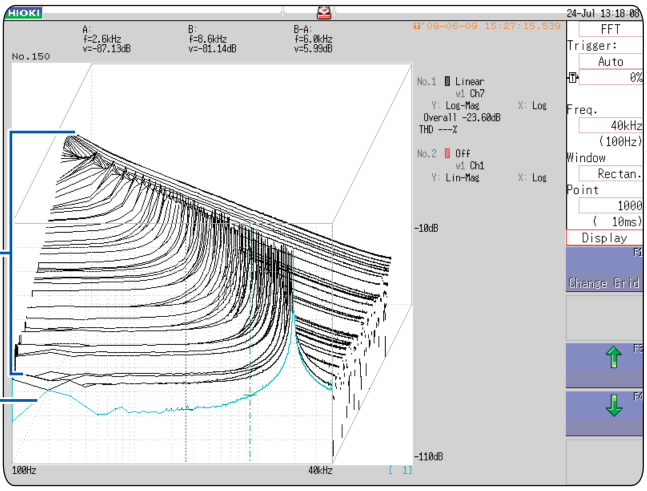
Procedure

Press the **DISP** key to open the Waveform screen.

To stop waveform movement during measurement

Wavefor movement can be stopped temporarily by pressing the **AUTO** key during measurement. The latest calculation results are displayed in the foreground.

To restart, press the **AUTO** key again.



Past waveforms

The latest waveform displayed during pausing of measurement

To read measurement values of past waveforms with the cursor

After measurement is finished, the values of each waveform can be read using the cursor.

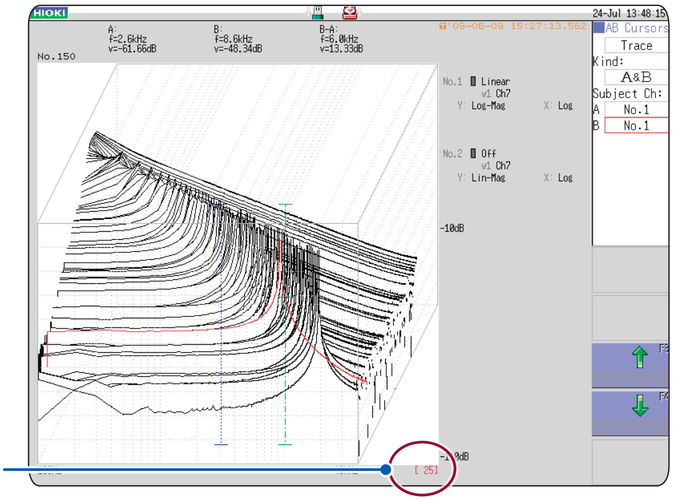
1 **Press the WAVE key on the panel of the unit.**

2 **Select a waveform.**

Use the jog and shuttle knobs to select the waveform.
(The waveform number is displayed in the lower right of the screen.)

3 **Move the cursor.**

Press the **AB CSR** key, then rotate the jog and shuttle to read the cursor value.



Older waveforms have larger numbers.

To change the grid display

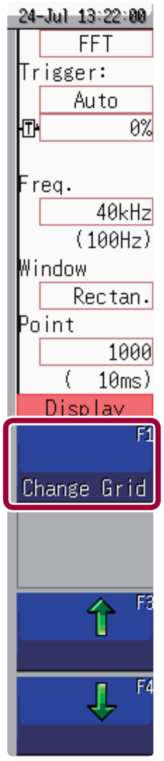
The display format of the grid can be selected.

1 **Press the WAVE key on the panel of the unit.**

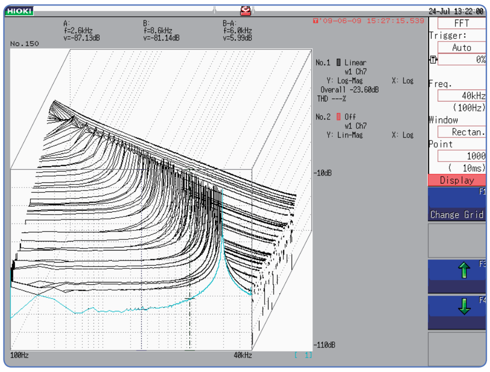
2 **Move the cursor to [Display].**

3 **To change the grid display**

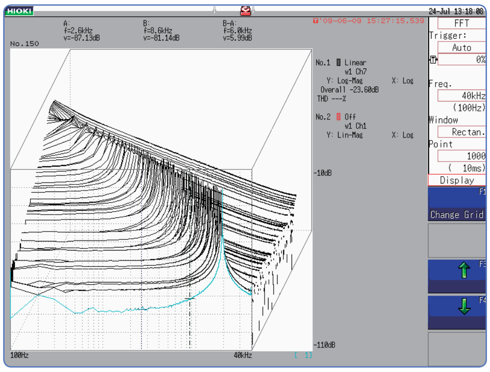
Press the **F1 [Change Grid]** key and change the grid display.
Each time the key is pressed, the display format changes.



24-Jul 13:22:00
FFT
Trigger:
Auto
0%
Freq.
40kHz
(100Hz)
Window
Rectan.
Point
1000
(10ms)
Display



Grid Type 1



Grid Type 2

To change the number of waveforms to be displayed.

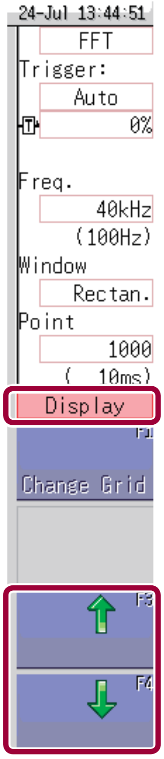
The number of waveforms to be displayed can be changed.
The following number of waveforms can be selected: 10, 20, 50, 100, and 200.

1 **Press the WAVE key on the panel of the unit.**

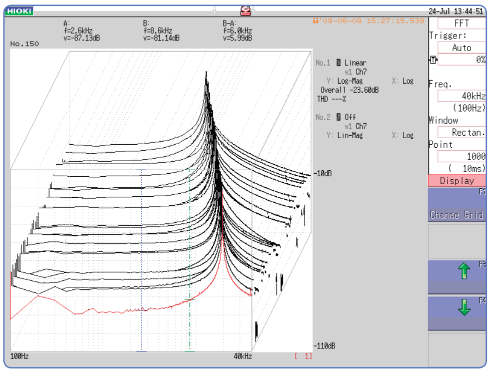
2 **Move the cursor to [Display].**

3 **Change the number of waveforms to be displayed.**

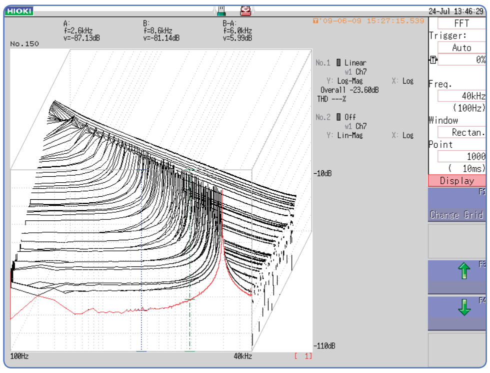
Using either the **F3 [↑]** or **F4 [↓]** key, adjust the number of waveforms to be displayed.



24-Jul 13:44:51
FFT
Trigger:
Auto
0%
Freq.
40kHz
(100Hz)
Window
Rectan.
Point
1000
(10ms)
Display



50 waveforms displayed



100 waveforms displayed

13.6 Save Analysis Results

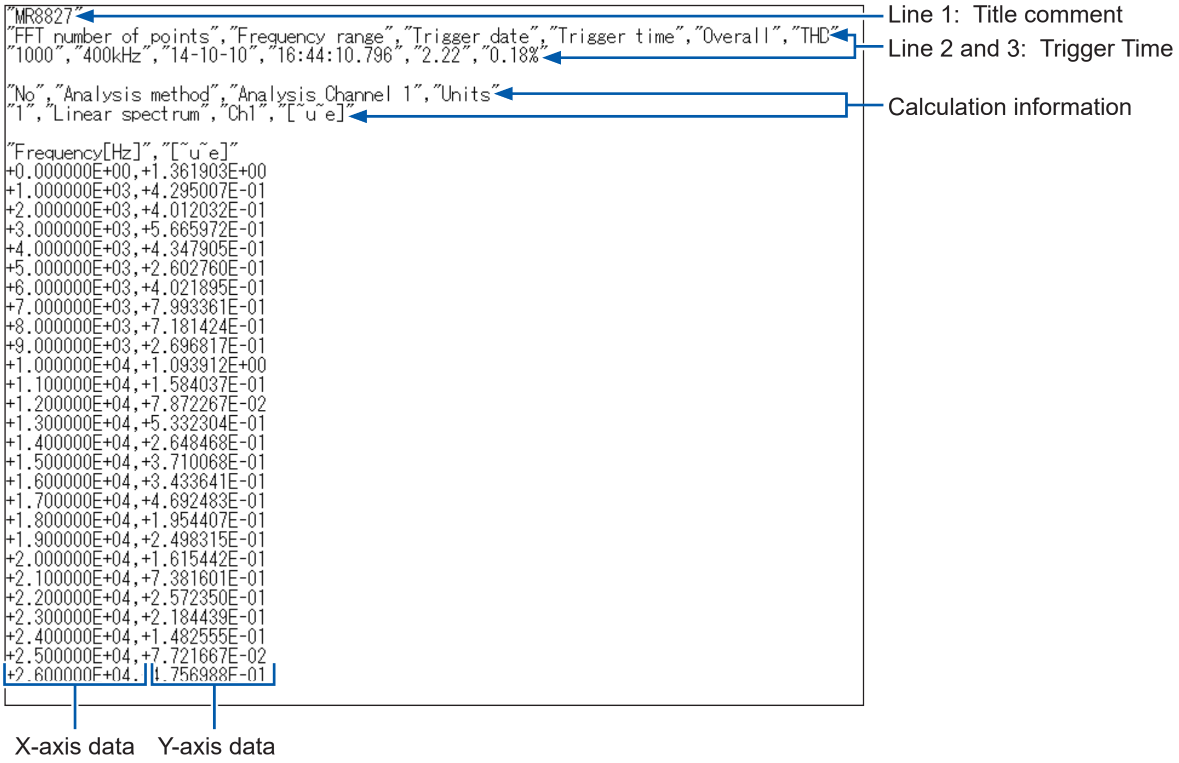
The procedure to save analysis results is the same as for the Memory and Recorder functions.
Refer to “5 Save/Load Data and Manage Files” (p. 83).

The size of saved files depends on the save format and analysis method.
Refer to “Appendix 2.1 Waveform File Sizes” (p. A2).

■ When FFT Analysis Results are Saved as Text

Each calculation item is saved to a separate file.

Text Save Example



```
"MR8827"
"FFT number of points","Frequency range","Trigger date","Trigger time","Overall","THD"
"1000","400kHz","14-10-10","16:44:10.796","2.22","0.18%"

"No","Analysis method","Analysis Channel 1","Units"
"1","Linear spectrum","Ch1","[~u~e]"

"Frequency[Hz]","[~u~e]"
+0.000000E+00,+1.361903E+00
+1.000000E+03,+4.295007E-01
+2.000000E+03,+4.012032E-01
+3.000000E+03,+5.665972E-01
+4.000000E+03,+4.347905E-01
+5.000000E+03,+2.602760E-01
+6.000000E+03,+4.021895E-01
+7.000000E+03,+7.993361E-01
+8.000000E+03,+7.181424E-01
+9.000000E+03,+2.696817E-01
+1.000000E+04,+1.093912E+00
+1.100000E+04,+1.584037E-01
+1.200000E+04,+7.872267E-02
+1.300000E+04,+5.332304E-01
+1.400000E+04,+2.648468E-01
+1.500000E+04,+3.710068E-01
+1.600000E+04,+3.433641E-01
+1.700000E+04,+4.692483E-01
+1.800000E+04,+1.954407E-01
+1.900000E+04,+2.498315E-01
+2.000000E+04,+1.615442E-01
+2.100000E+04,+7.381601E-01
+2.200000E+04,+2.572350E-01
+2.300000E+04,+2.184439E-01
+2.400000E+04,+1.482555E-01
+2.500000E+04,+7.721667E-02
+2.600000E+04,+4.756988E-01
```

Line 1: Title comment

Line 2 and 3: Trigger Time

Calculation information

X-axis data

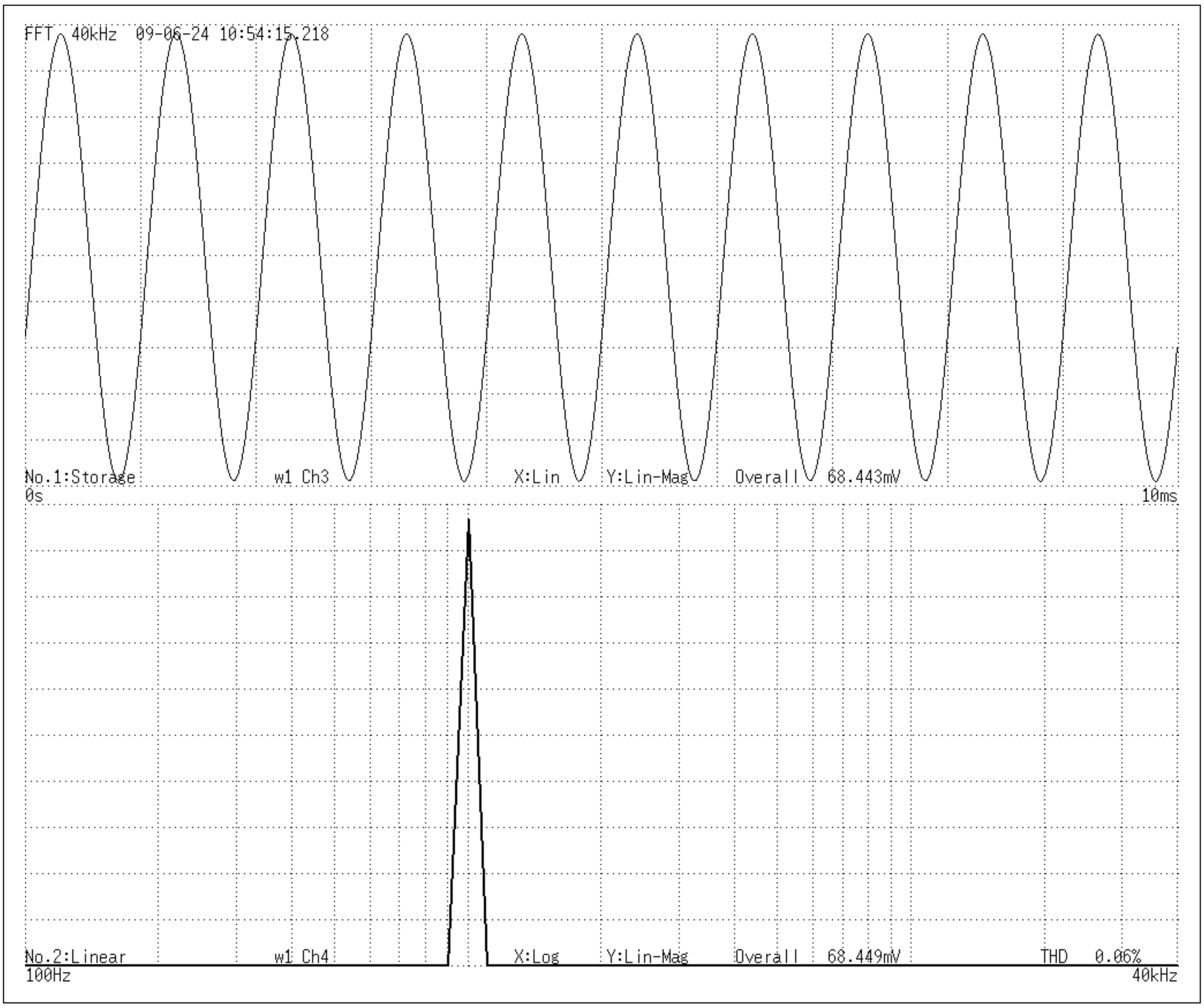
Y-axis data

If trigger time is not displayed properly when you open a file with Microsoft Excel®, select “Custom” for **[Format]** of **[Format Cells]** and enter “hh:mm:ss.000” for Type.

13.7 Print Analysis Results

The printing procedure is the same as for the Memory and Recorder functions.
Refer to “6 Printing (When Model U8350 Printer Unit is installed)” (p. 113).

Example Waveform Print



13.8 Analysis With the Waveform Screen

13.8.1 Analyze After Specifying an Analysis Starting Point

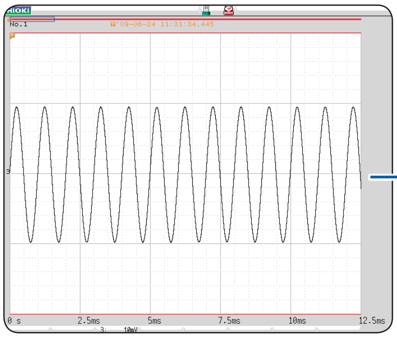
The FFT function can specify the calculation start position for waveforms previously measured using the memory function.

Operation differs depending on the calculation execution settings.
Refer to “Trigger Modes and Averaging” (p. 262).

- **Calculation execution: [Single]**
  Analysis is performed once on the specified number of analysis points beginning with the specified starting point, and analysis results are displayed.
  This is convenient for analyzing only a specific range. However, if averaging is enabled, analysis repeats for the specified averaging count.

- **Calculation execution: [Repeat]**
  Analysis is performed repeatedly on the specified number of analysis points beginning with the specified starting point and ending with end of waveform data, and final analysis results are displayed (Calculation is performed for the number of specified points so a good end point becomes the final analysis result).

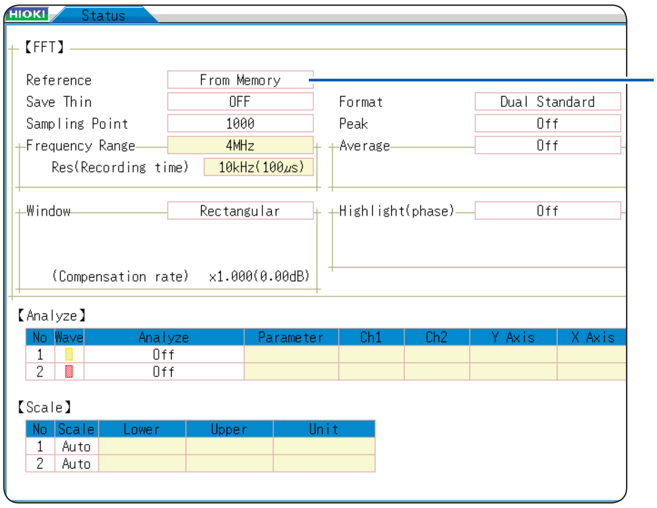
To Verify the Analysis Starting Point While Viewing Analysis Data



1 **Display the waveform with the Memory function.**

2 **Switch to FFT function.**

3 **Press the STATUS key to display the [Status] sheet of the Status screen.**



【FFT】

Reference: From Memory
Save Thin: OFF
Sampling Point: 1000
Frequency Range: 4MHz
Res(Recording time): 10kHz(100μs)
Format: Dual Standard
Peak: Off
Average: Off
Window: Rectangular
(Compensation rate) x1.000(0.00dB)
Highlight(phase): Off

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

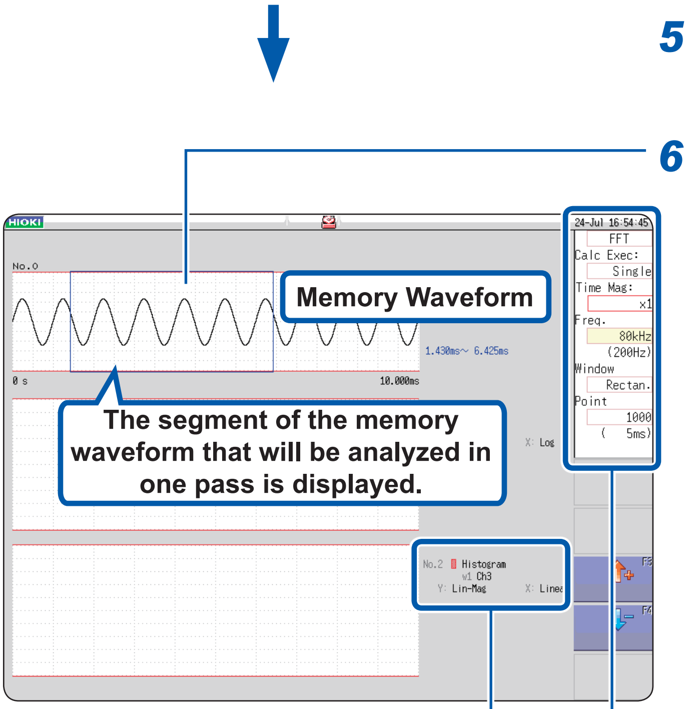
4 **Set [Reference] to [From Memory].**

Set analysis conditions such as the analysis mode and number of analysis points (these can also be set on the Waveform screen).

5 **Press the DISP key to display the Waveform screen.**

The one-time calculation range is displayed for the memory waveform.

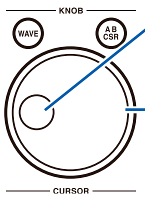
6 **Specify the location of the analysis input data using the jog and shuttle controls.**



Memory Waveform

The segment of the memory waveform that will be analyzed in one pass is displayed.

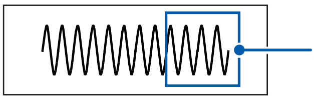
24-Jul 16:54:45
FFT
Calc Exec:
Single
Time Mag:
x1
Freq.
80kHz
(200Hz)
Window
Rectan.
Point
1000
(5ms)



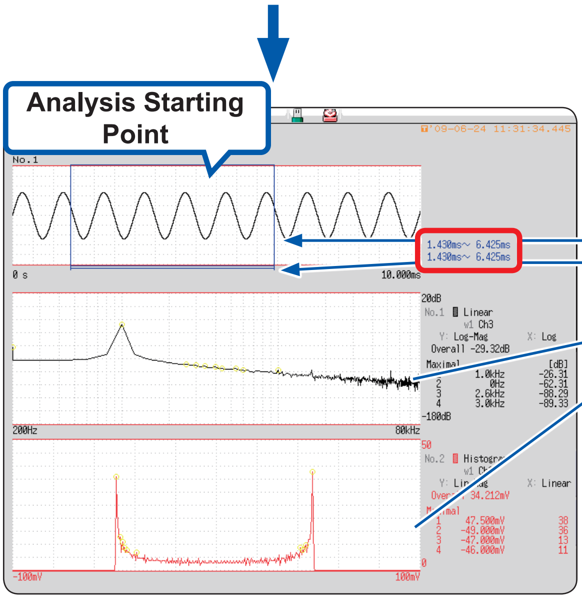
Jog
Moves the analysis starting point.

Shuttle
Scrolls the Memory waveform.

7 **Select analysis conditions as needed.**

To change the number of analysis points	The setting can be changed at the top of the Waveform screen. The range is determined by the number of analysis points. If the analysis range (number of points) goes past the end of the memory waveform as shown below, analysis will not be performed.  Analysis Segment Display
To analyze only a certain portion	If **[Exec]** is **[Single]** in the setting items at the right side of the screen, only the calculation range currently displayed will be calculated. For settings other than **[Single]**, calculation points are calculated until the end of the waveform data. To interrupt calculation, press the **STOP** key.

8 **Use [Exec] or press the START key to perform analysis.**



Analysis Starting Point

'09-06-24 11:31:34.445
1.430ms~ 6.425ms
1.430ms~ 6.425ms
No.1 Linear
w1 Ch3
Y: Log-Mag X: Log
Overall -29.32dB
Maximal [dB]
1 1.0kHz -26.31
2 0Hz -62.31
3 2.6kHz -88.29
4 3.0kHz -89.33
No.2 Histogram
w1 Ch3
Y: Lin-Mag X: Linear
Overall 34.212mV
Maximal
1 47.500mV 38
2 -49.000mV 36
3 -47.000mV 13
4 -46.000mV 11

Calculation range (portion in square)
Last range calculated (line portion)
Analysis results are displayed on the lower graphs.

When the trigger mode is **[Auto]** or **[Repeat]**, the number of analysis points up to the end of the waveform data is analyzed, and the last data is displayed.
Memory waveforms are not printed.

13.9 FFT Analysis Modes

13.9.1 Analysis Modes and Display Examples

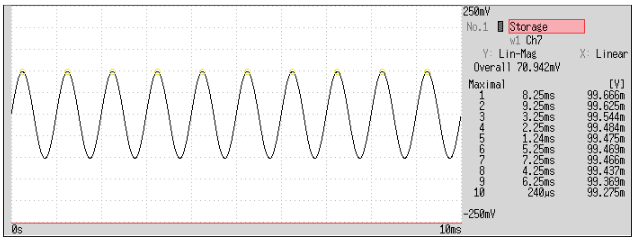
For the functions of each analysis mode, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Storage

Displays the time-domain waveform of the input signal.
When the window function setting is other than rectangular, the window function is applied to the time-domain waveform before it is displayed.

Axis	Display type	Description
X axis	Linear	Time-domain display Displays the value of the time-domain waveform corresponding to the set frequency range. Refer to “Relationship Between Frequency Range, Resolution and Number of Analysis Points” (p. 256).
Y axis	Lin-Mag	Displays the module waveform

Waveform Example



```
No.1   Storage
       w1 Ch7
  Y: Lin-Mag           X: Linear
 Overall 70.942mV
Maximal                      [V]
  1        8.25ms       99.666m
  2        9.25ms       99.625m
  3        3.25ms       99.544m
  4        2.25ms       99.484m
  5        1.24ms       99.475m
  6        5.25ms       99.469m
  7        7.25ms       99.466m
  8        4.25ms       99.437m
  9        6.25ms       99.369m
 10         240µs       99.275m
```

Window: Rectangular
X axis: Linear
Y axis: Lin-Mag

Histogram

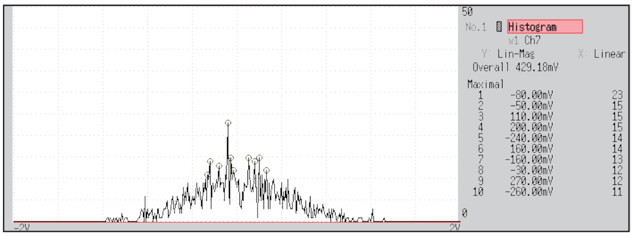
Acquires the amplitude distribution of the input signal.
Main uses:

- To inspect deviations in the amplitude range of a waveform
- Uses analysis point distribution to ascertain whether a waveform is artificial or natural

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays input level of the input signal.
Y axis	Lin-Mag	Displays analysis data distribution.

Waveform Example



```
No.1   Histogram
       w1 Ch7
  Y: Lin-Mag           X: Linear
 Overall 429.18mV
Maximal
  1     -80.00mV          23
  2     -50.00mV          15
  3     110.00mV          15
  4     200.00mV          15
  5    -240.00mV          14
  6     160.00mV          14
  7    -160.00mV          13
  8     -30.00mV          12
  9     270.00mV          12
 10    -260.00mV          11
```

Normal display
X axis: Linear
Y axis: Lin-Mag

Linear Spectrum

The linear spectrum plots the input signal frequency. It can also be displayed as a Nyquist plot.

Main uses:

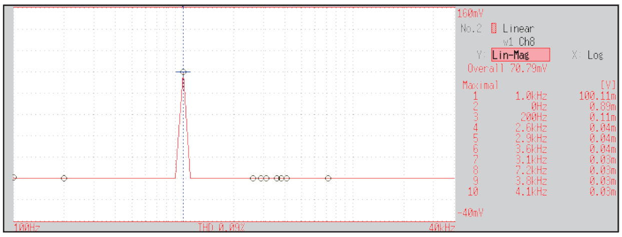
- To inspect the peak frequency contents of a waveform
- To inspect signal amplitudes at each frequency

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
	Nyquist display	The real-number component of analysis values is displayed linearly.
Y axis	Lin-Mag	Displays analysis values linearly.
	Log-Mag	Display analysis results as dB values. (0 dB reference value: 1eu)*
	Lin-Real	Display the real-number component of analysis values.
	Lin-Imag	Display the imaginary component of analysis values.
	Nyquist display	Display the imaginary component of analysis values.

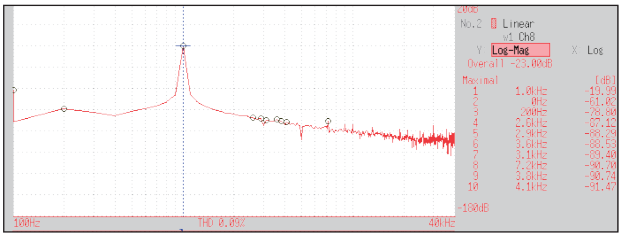
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

Waveform Example



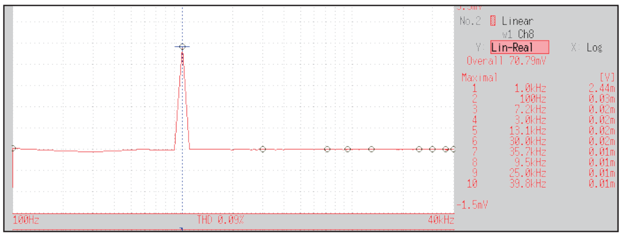
```
No.2   Linear
        w1 Ch8
   Y: Lin-Mag      X: Log
 Overall 70.79mV
Maximal                 [V]
 1       1.0kHz     100.11m
 2          0Hz       0.89m
 3        200Hz       0.11m
 4       2.6kHz       0.04m
 5       2.9kHz       0.04m
 6       3.6kHz       0.04m
 7       3.1kHz       0.03m
 8       7.2kHz       0.03m
 9       3.8kHz       0.03m
10       4.1kHz       0.03m
```

Normal display
X axis: Log
Y axis: Lin-Mag



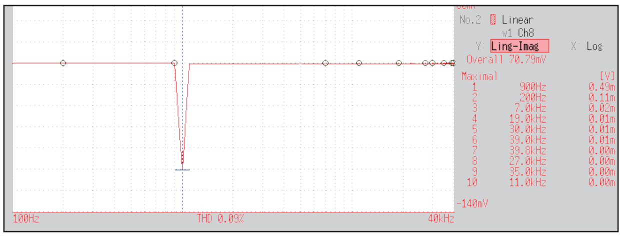
```
No.2   Linear
        w1 Ch8
   Y: Log-Mag      X: Log
 Overall -23.00dB
Maximal                [dB]
 1       1.0kHz      -19.99
 2          0Hz      -61.02
 3        200Hz      -78.80
 4       2.6kHz      -87.12
 5       2.9kHz      -88.29
 6       3.6kHz      -88.53
 7       3.1kHz      -89.40
 8       7.2kHz      -90.70
 9       3.8kHz      -90.74
10       4.1kHz      -91.47
```

Normal display
X axis: Log
Y axis: Log-Mag



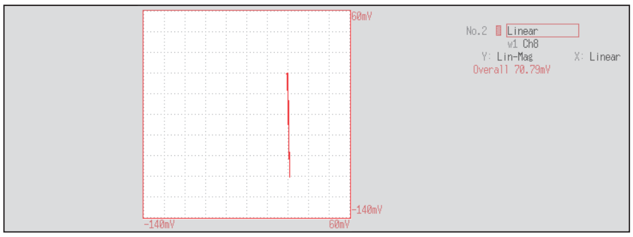
```
No.2   Linear
        w1 Ch8
   Y: Lin-Real     X: Log
 Overall 70.79mV
Maximal                 [V]
 1       1.0kHz       2.44m
 2        100Hz       0.03m
 3       7.2kHz       0.02m
 4       3.0kHz       0.02m
 5      13.1kHz       0.02m
 6      30.0kHz       0.02m
 7      35.7kHz       0.01m
 8       9.5kHz       0.01m
 9      25.0kHz       0.01m
10      39.8kHz       0.01m
```

Normal display
X axis: Log
Y axis: Lin-Real



```
No.2   Linear
        w1 Ch8
   Y: Ling-Imag    X: Log
 Overall 70.79mV
Maximal                 [V]
 1        900Hz       0.49m
 2        200Hz       0.11m
 3       7.0kHz       0.02m
 4      19.0kHz       0.01m
 5      30.0kHz       0.01m
 6      39.0kHz       0.01m
 7      39.8kHz       0.00m
 8      27.0kHz       0.00m
 9      35.0kHz       0.00m
10      11.0kHz       0.00m
```

Normal display
X axis: Log
Y axis: Lin-Imag



Nyquist display

- If the cursor is displayed, the total harmonic distortion (THD) with the fundamental wave set to the cursor position will be displayed. When 2 cursors appear, the A cursor becomes the fundamental wave. When results cannot be obtained, **[---%]** is displayed.
- When only sine waves are input, the level of this component becomes approximately 1.4 times (3 dB) larger than the overall value. To measure at a reference the same as the overall value, analyze using RMS spectrum or power spectrum.
  Refer to “RMS Spectrum” (p. 282) or “Power Spectrum” (p. 283).

RMS Spectrum

The oscillation component (actual value) is calculated from the frequency axis waveform of the input signal.
RMS and power spectra displays use the same analysis results displayed logarithmically (amplitude in dB).
Main uses:

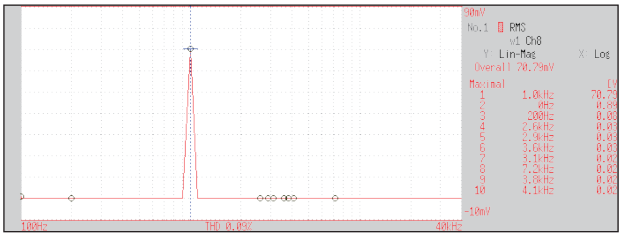
- To inspect the execution value of the frequency component of the waveform
- To inspect the RMS value of each frequency

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Displays analysis values linearly.
	Log-Mag	Display analysis results as dB values. (0 dB reference value: 1eu)*
	Lin-Real	Display the real-number component of analysis values.
	Lin-Imag	Display the imaginary component of analysis values.

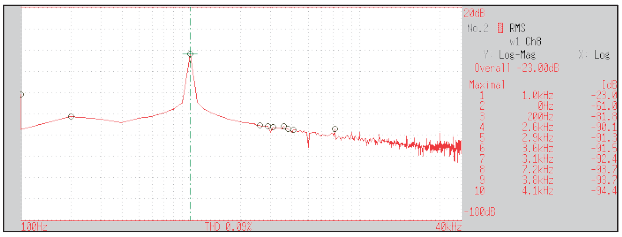
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

Waveform Example



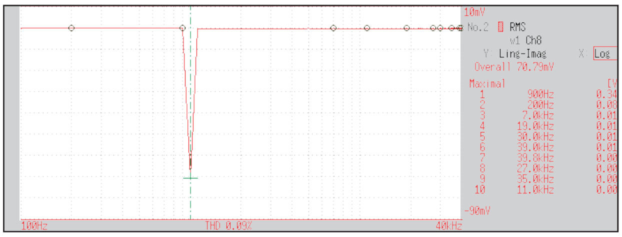
```
90mV
No.1   RMS
     w1 Ch8
  Y: Lin-Mag        X: Log
 Overall 70.79mV
Maximal                 [V
  1      1.0kHz      70.79
  2         0Hz       0.89
  3       200Hz       0.08
  4      2.6kHz       0.03
  5      2.9kHz       0.03
  6      3.6kHz       0.03
  7      3.1kHz       0.02
  8      7.2kHz       0.02
  9      3.8kHz       0.02
 10      4.1kHz       0.02
-10mV
100Hz        THD 0.09%        40kHz
```

Normal display
X axis: Log
Y axis: Lin-Mag



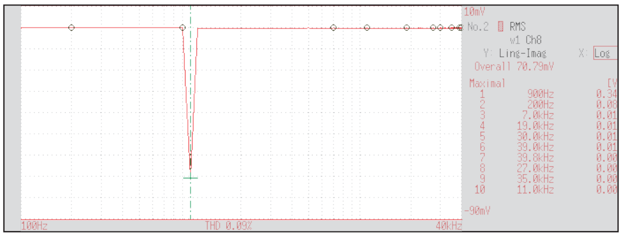
```
20dB
No.2   RMS
     w1 Ch8
  Y: Log-Mag        X: Log
 Overall -23.00dB
Maximal                [dB
  1      1.0kHz      -23.0
  2         0Hz      -61.0
  3       200Hz      -81.8
  4      2.6kHz      -90.1
  5      2.9kHz      -91.3
  6      3.6kHz      -91.5
  7      3.1kHz      -92.4
  8      7.2kHz      -93.7
  9      3.8kHz      -93.7
 10      4.1kHz      -94.4
-180dB
100Hz        THD 0.09%        40kHz
```

Normal display
X axis: Log
Y axis: Log-Mag



```
10mV
No.2   RMS
     w1 Ch8
  Y: Ling-Imag      X: Log
 Overall 70.79mV
Maximal                 [V
  1       900Hz       0.34
  2       200Hz       0.08
  3      7.0kHz       0.01
  4     19.0kHz       0.01
  5     30.0kHz       0.01
  6     39.0kHz       0.01
  7     39.8kHz       0.00
  8     27.0kHz       0.00
  9     35.0kHz       0.00
 10     11.0kHz       0.00
-90mV
100Hz        THD 0.09%        40kHz
```

Normal display
X axis: Log
Y axis: Lin-Real



```
10mV
No.2   RMS
     w1 Ch8
  Y: Ling-Imag      X: Log
 Overall 70.79mV
Maximal                 [V
  1       900Hz       0.34
  2       200Hz       0.08
  3      7.0kHz       0.01
  4     19.0kHz       0.01
  5     30.0kHz       0.01
  6     39.0kHz       0.01
  7     39.8kHz       0.00
  8     27.0kHz       0.00
  9     35.0kHz       0.00
 10     11.0kHz       0.00
-90mV
100Hz        THD 0.09%        40kHz
```

Normal display
X axis: Log
Y axis: Lin-Imag

If the cursor is displayed, the total harmonic distortion (THD) with the fundamental wave set to the cursor position will be displayed. When 2 cursors appear, the A cursor becomes the fundamental wave. When results cannot be obtained, **[---%]** is displayed.

Power Spectrum

Displays input signal power as the amplitude component.
Main uses:

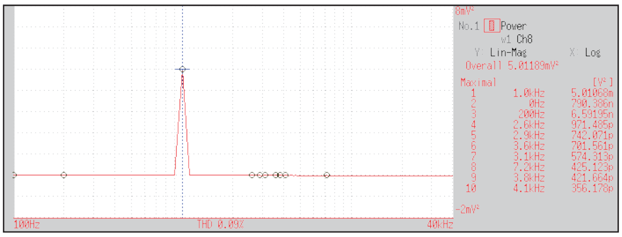
- To inspect the peak frequency contents of a waveform
- To inspect the power level of each frequency

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Analysis data is displayed linearly as squared values. Indicates the power component.
	Log-Mag(logarithm)	Display analysis results as dB values. (0 dB reference value: $1eu^2$)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2)

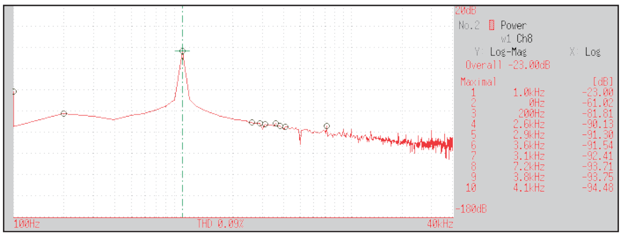
Waveform Example



No.1 Power
w1 Ch8
Y: Lin-Mag X: Log
Overall 5.01189mV²

Maximal		[V²]
1	1.0kHz	5.01068m
2	0Hz	790.386n
3	200Hz	6.59195n
4	2.6kHz	971.485p
5	2.9kHz	742.071p
6	3.6kHz	701.561p
7	3.1kHz	574.313p
8	7.2kHz	425.123p
9	3.8kHz	421.664p
10	4.1kHz	356.178p

Normal display
X axis: Log
Y axis: Lin-Mag



No.2 Power
w1 Ch8
Y: Log-Mag X: Log
Overall -23.00dB

Maximal		[dB]
1	1.0kHz	-23.00
2	0Hz	-61.02
3	200Hz	-81.81
4	2.6kHz	-90.13
5	2.9kHz	-91.30
6	3.6kHz	-91.54
7	3.1kHz	-92.41
8	7.2kHz	-93.71
9	3.8kHz	-93.75
10	4.1kHz	-94.48

Normal display
X axis: Log
Y axis: Log-Mag

If the cursor is displayed, the total harmonic distortion (THD) with the fundamental wave set to the cursor position will be displayed. When 2 cursors appear, the A cursor becomes the fundamental wave. When results cannot be obtained, **[---%]** is displayed.

Power Spectrum Density

Indicates the power spectrum density of the input signal with only the amplitude component included. This is the power spectrum divided by the frequency resolution.

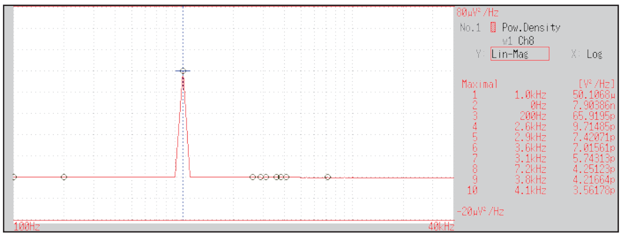
Main uses:

To acquire a power spectrum with 1-Hz resolution for highly irregular waveforms such as white noise
About the Functions, refer to "13.9.2 Analysis Mode Functions" (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Displays analysis values linearly.
	Log-Mag(logarithm)	Display analysis results as dB values. (0 dB reference value: 1eu^2/Hz)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2/Hz)

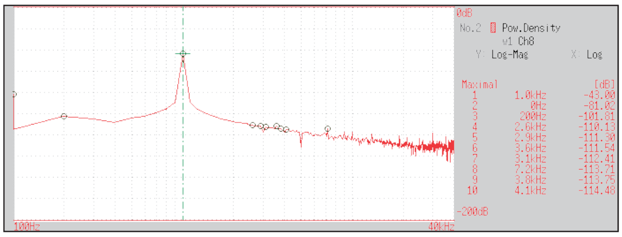
Waveform Example



No.1 Pow.Density
w1 Ch8
Y: Lin-Mag X: Log

Maximal		[V²/Hz]
1	1.0kHz	50.1068μ
2	0Hz	7.90386n
3	200Hz	65.9195p
4	2.6kHz	9.71485p
5	2.9kHz	7.42071p
6	3.6kHz	7.01561p
7	3.1kHz	5.74313p
8	7.2kHz	4.25123p
9	3.8kHz	4.21664p
10	4.1kHz	3.56178p

Normal display
X axis: Log
Y axis: Lin-Mag



No.2 Pow.Density
w1 Ch8
Y: Log-Mag X: Log

Maximal		[dB]
1	1.0kHz	-43.00
2	0Hz	-81.02
3	200Hz	-101.81
4	2.6kHz	-110.13
5	2.9kHz	-111.30
6	3.6kHz	-111.54
7	3.1kHz	-112.41
8	7.2kHz	-113.71
9	3.8kHz	-113.75
10	4.1kHz	-114.48

Normal display
X axis: Log
Y axis: Log-Mag

Not available with external sampling enabled.

Linear Predictive Cording (LPC) Analysis (Power Spectrum Density)

When the spectrum shape is complex and hard to understand with either linear or power spectra, a rough spectrum structure can be obtained.

Main uses:

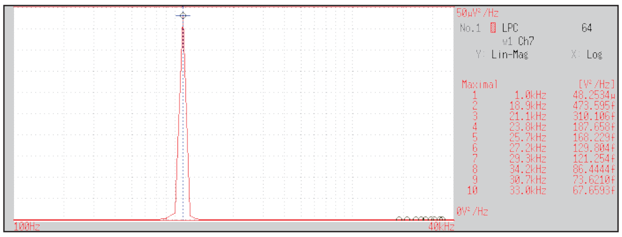
To obtain a spectral envelope using statistical methods

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Displays analysis values linearly.
	Log-Mag(logarithm)	Display analysis results as dB values. (0 dB reference value: 1eu^2/Hz)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2/Hz)

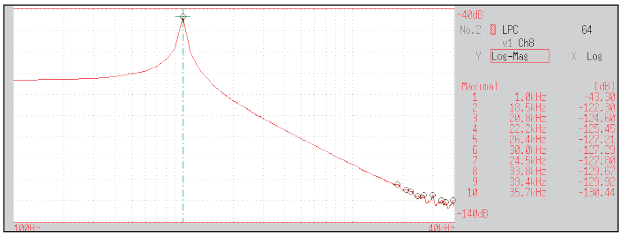
Waveform Example



No.1 LPC 64
w1 Ch7
Y: Lin-Mag X: Log

Maximal		[V²/Hz]
1	1.0kHz	48.2534µ
2	18.9kHz	473.595f
3	21.1kHz	310.106f
4	23.8kHz	187.658f
5	25.7kHz	168.229f
6	27.2kHz	129.804f
7	29.3kHz	121.254f
8	34.2kHz	86.4444f
9	30.7kHz	73.6210f
10	33.0kHz	67.6593f

X axis: Log
Y axis: Lin-Mag



No.2 LPC 64
w1 Ch8
Y: Log-Mag X: Log

Maximal		[dB]
1	1.0kHz	-43.30
2	18.5kHz	-122.30
3	20.8kHz	-124.60
4	22.2kHz	-125.45
5	26.4kHz	-127.21
6	30.0kHz	-127.29
7	24.5kHz	-127.80
8	33.8kHz	-129.67
9	39.4kHz	-129.92
10	35.7kHz	-130.44

X axis: Log
Y axis: Log-Mag

- Always specify the order (from 2 to 64). Higher orders can expose finer spectral details.
- Amplitude values provided by LPC are not always the same as the power spectrum density.
- If an error occurs during analysis, no waveform will be displayed.
- Noise-like phenomena can strongly affect the spectrum shape.
- Not available with external sampling enabled.

Transfer Function

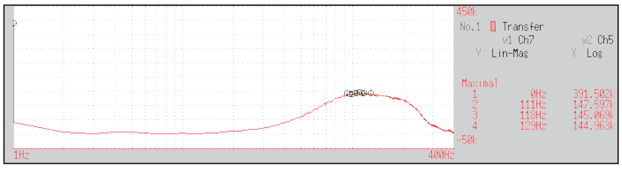
From the input and output signals, the transfer function (frequency characteristic) of a measurement system can be obtained. It can also be displayed as a Nyquist plot.
Main uses:

- To inspect a filter’s frequency characteristic
- To inspect the stability of a feedback control system (using the Nyquist plot)
- To inspect the resonance characteristic of an object using an impulse hammer and pick-up sensor

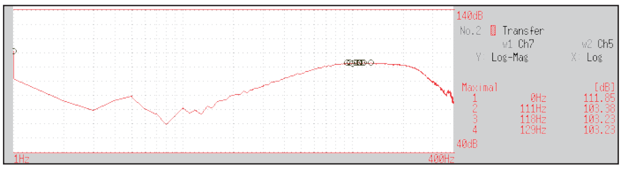
About the Functions, refer to“13.9.2 Analysis Mode Functions” (p. 297) or Refer to “Linear Time-Invariant Systems” (p. A14).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
	Nyquist display	Displays the real-number component of the input-output ratio.
Y axis	Lin-Mag	Displays the input-output ratio linearly (dimensionless units).
	Log-Mag(logarithm)	Displays the input-output ratio as dB values.
	Lin-Real	Displays the real-number component of the input-output ratio. (dimensionless units)
	Lin-Imag	Displays the imaginary component of the input-output ratio. (dimensionless units)
	Nyquist display	Displays the imaginary component of the input-output ratio.

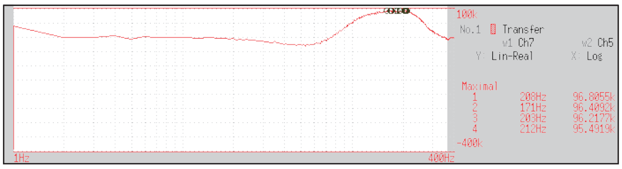
Waveform Example



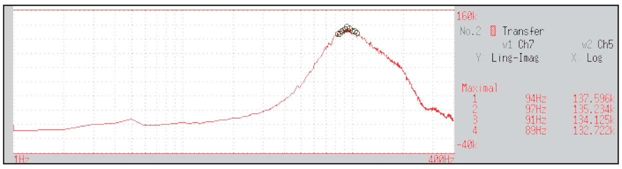
Normal display
X axis: Log
Y axis: Lin-Mag



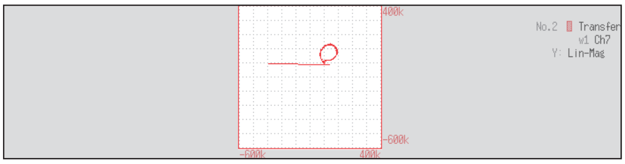
Normal display
X axis: Log
Y axis: Log-Mag



Normal display
X axis: Log
Y axis: Lin-Real



Normal display
X axis: Log
Y axis: Lin-Imag



Nyquist display

Cross Power Spectrum

The product of the spectra of two input signals or common frequency components of two signals can be obtained.

Using the voltage and current waveforms as input signals, active power, reactive power and apparent power can be obtained for each frequency.

Main uses:

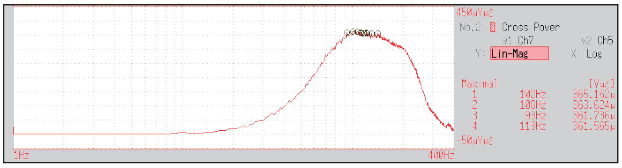
To inspect common frequency components of two signals

About the Functions, refer to "13.9.2 Analysis Mode Functions" (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
	Nyquist display	Displays the real-number component of the input-output ratio linearly.
Y axis	Lin-Mag	Displays the squared value of amplitude contents of analysis data linearly.
	Log-Mag(logarithm)	Displays the dB value of amplitude contents of analysis data linearly. (0 dB reference value: 1eu^2)*
	Lin-Real	Displays the squared values of the real component of analysis data linearly.
	Lin-Imag	Displays the squared values of the imaginary component of analysis data linearly.
	Nyquist display	Displays the imaginary component of analysis data linearly.

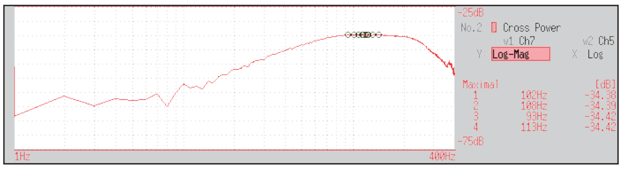
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2)

Waveform Example



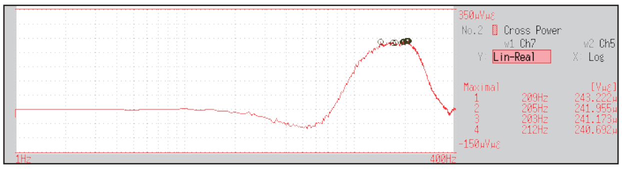
```
No.2   Cross Power
         w1 Ch7          w2 Ch5
    Y: Lin-Mag           X: Log

Maximal                  [Vµε]
  1          102Hz    365.162µ
  2          108Hz    363.624µ
  3           93Hz    361.736µ
  4          113Hz    361.565µ
```

Normal display
X axis: Log
Y axis: Lin-Mag



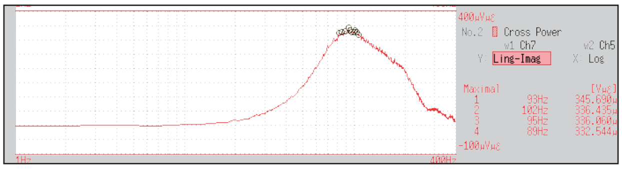
```
No.2   Cross Power
         w1 Ch7          w2 Ch5
    Y: Log-Mag           X: Log

Maximal                   [dB]
  1          102Hz      -34.38
  2          108Hz      -34.39
  3           93Hz      -34.42
  4          113Hz      -34.42
```

Normal display
X axis: Log
Y axis: Log-Mag



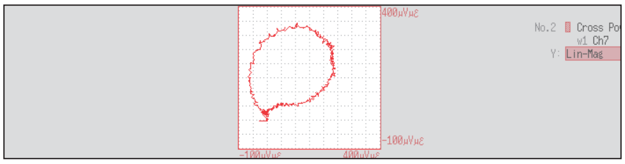
```
No.2   Cross Power
         w1 Ch7          w2 Ch5
    Y: Lin-Real          X: Log

Maximal                  [Vµε]
  1          209Hz    243.222µ
  2          205Hz    241.955µ
  3          203Hz    241.173µ
  4          212Hz    240.692µ
```

Normal display
X axis: Log
Y axis: Lin-Real



```
No.2   Cross Power
         w1 Ch7          w2 Ch5
    Y: Ling-Imag         X: Log

Maximal                  [Vµε]
  1           93Hz    345.690µ
  2          102Hz    336.435µ
  3           95Hz    336.060µ
  4           89Hz    332.544µ
```

Normal display
X axis: Log
Y axis: Lin-Imag



```
No.2   Cross Po
         w1 Ch7
    Y: Lin-Mag
```

Nyquist display

Impulse Response

Calculates the transfer characteristic of a system as a time-domain waveform.
By using both output and input signals of a measurement system, a unit impulse is applied to the system and the corresponding response waveform is obtained.

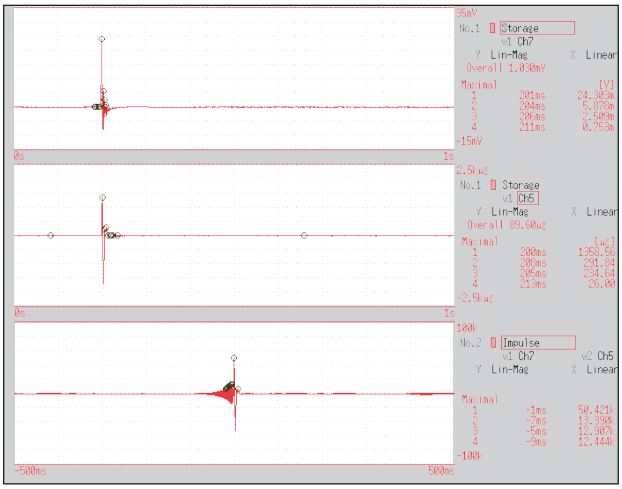
Main uses:

To inspect circuit time constants

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297) or “Linear Time-Invariant Systems” (p. A14).

Axis	Display type	Description
X axis	Linear	Time display The center (t = 0) is the reference. To the right is lag time (+t), and to the left is lead time (-t)
Y axis	Lin-Mag	Displays the transfer function provided by inverse Fourier transformation.

Waveform Example



```
35mV
No.1   Storage
       w1 Ch7
  Y: Lin-Mag          X: Linear
  Overall 1.030mV
 Maximal                    [V]
  1          201ms     24.303m
  2          204ms      5.878m
  3          206ms      2.509m
  4          211ms      0.753m
-15mV

2.5kμε
No.1   Storage
       w1 Ch5
  Y: Lin-Mag          X: Linear
  Overall 89.60με
 Maximal                   [με]
  1          200ms     1358.56
  2          208ms      291.84
  3          205ms      234.64
  4          213ms       26.00
-2.5kμε

100k
No.2   Impulse
       w1 Ch7          w2 Ch5
  Y: Lin-Mag          X: Linear

 Maximal
  1           -1ms     50.421k
  2           -7ms     13.390k
  3           -5ms     12.907k
  4           -9ms     12.444k
-100k
```

Normal display
X axis: Linear
Y axis: Lin-Mag

Input signal 1

Input signal 2

Impulse Response

Coherence Function

This function gives a measure of the correlation (coherence) between input and output signals. Values obtained are between 0 and 1.

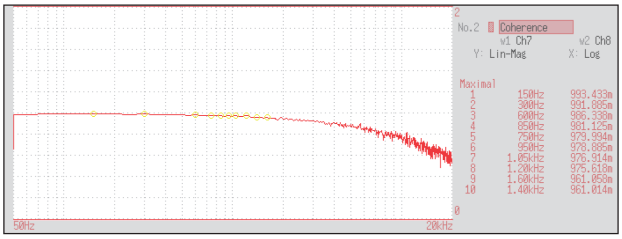
Main uses:

- To evaluate transfer functions
- In a system with multiple inputs, to inspect the effect of each input on the output

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Displays the causal relationship and degree of relationship between two input signals, as a value between 0 and 1 (dimensionless units).

Waveform Example



```
No.2   Coherence
       w1 Ch7          w2 Ch8
  Y: Lin-Mag        X: Log

Maximal
  1        150Hz   993.433m
  2        300Hz   991.885m
  3        600Hz   986.338m
  4        850Hz   981.125m
  5        750Hz   979.994m
  6        950Hz   978.885m
  7      1.05kHz   976.914m
  8      1.20kHz   975.618m
  9      1.60kHz   961.058m
 10      1.40kHz   961.014m
```

Normal display
X axis: Log
Y axis: Lin-Mag

- With a single measurement, the coherence function gives a value of one for all frequencies. Spectrum (frequency-domain) averaging should always be performed before measurement (analysis is not available with time-domain averaging).
- The coherence function has two general definition formulas. For the definition formulas, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Phase Spectrum

Shows the phase characteristics of the input signal.

Main uses:

- To inspect the phase spectrum of channel 1. Displays the phase of a cosine waveform as a reference (0°).
- To inspect the phase difference between channels 1 and 2.

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

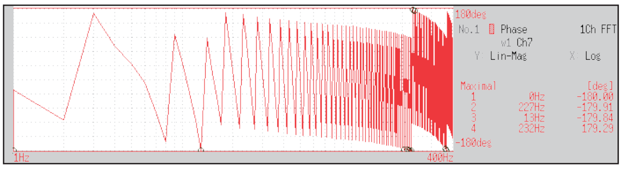
Although the unit for angle is [°], it is shown **[deg]** on the screen.

1ch FFT: Displays the phase of the signal on channel 1. Displays the phase of a cosine waveform as a reference (0°). Unless the waveform is synchronous, phase values are unstable.

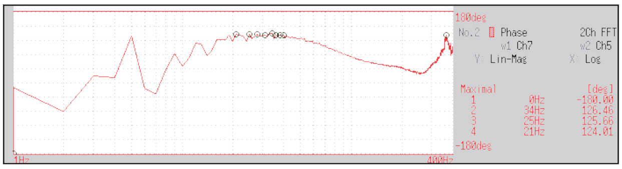
2ch FFT: Displays the phase difference between channels 1 and 2. Positive values indicate that the phase of channel 2 is leading.

Axis	Display type	Description
X axis	Linear	Displays the frequency on a linear scale
	Log	Displays the frequency on a logarithm scale
Y axis	Lin-Mag	Displays analysis values linearly.

Waveform Example



1ch FFT
X axis: Log
Y axis: Lin-Mag



2ch FFT
X axis: Log
Y axis: Lin-Mag

■ Emphasizing Only a Specific Portion (Highlighted Display)

A specific portion of a phase spectrum can be emphasized and displayed.
Refer to “13.3.8 Emphasize Analysis Results (Phase Spectra Only)” (p. 263).

Auto-correlation Function

Shows the correlation of two points on the input signal at time differential *t*.

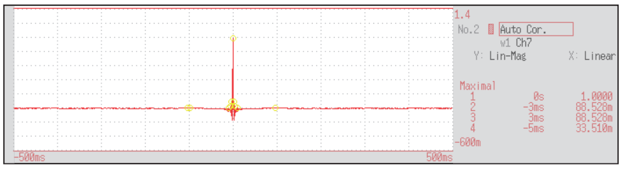
Main uses:

- To detect periodicity in irregular signals (improving and detecting SNR)
- To inspect periodic components in a noisy waveform.

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Time display The center (*t* = 0) is the reference. To the right is lag time (+*t*), and to the left is lead time (-*t*)
Y axis	Lin-Mag	+1 to −1 (dimensionless units) The closest correlation at time differential *t* is +1, and the least correlation is 0. −1 indicates completely reversed polarity. Because of the characteristics of the function, *t* = 0 becomes +1.

Waveform Example



```
Maximal
  1        0s     1.0000
  2     -3ms    88.528m
  3      3ms    88.528m
  4     -5ms    33.510m
```

X axis: Linear
Y axis: Lin-Mag

This instrument provides a circular auto-correlation function. Analysis results are normalized to the maximum value.

Cross-Correlation Function

Shows the correlation of two points on tow input signals at time differential *t*. Output is displayed as a function of differential time *t*.

Main uses:

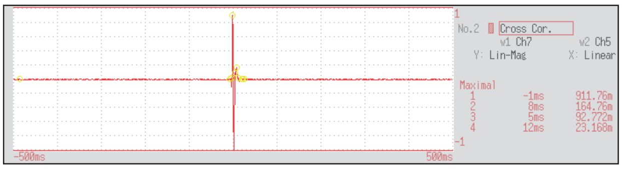
To determine the phase shift of two signals per unit of time

To determine the speed and distance of time lag between two signals

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297).

Axis	Display type	Description
X axis	Linear	Time display The center (*t* = 0) is the reference. To the right is lag time (+*t*), and to the left is lead time (-*t*)
Y axis	Lin-Mag	+1 to −1 is displayed in dimensionless units. At time differential *t*, this value is +1 when the correlation of input and output signals is the closest, and 0 when correlation is the least. −1 indicates completely reversed polarity.

Waveform Example



No.2 Cross Cor.
w1 Ch7 w2 Ch5
Y: Lin-Mag X: Linear

Maximal

1	-1ms	911.76m
2	8ms	164.76m
3	5ms	92.772m
4	12ms	23.168m

X axis: Linear
Y axis: Lin-Mag

This instrument provides a circular cross-correlation function.
Analysis results are normalized to the maximum value.

1/1 Octave, 1/3 Octave

Analyze spectrums such as noise using fixed rate spectrum filters of 1/1 octave band or 1/3 octave band.

Main uses:

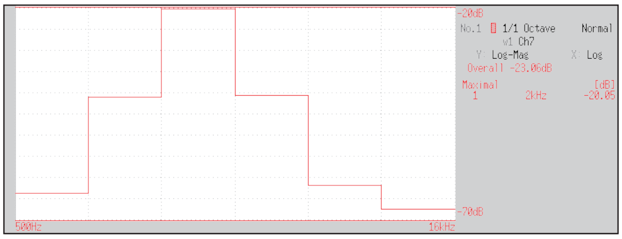
To analyze noise frequency

About the Functions, refer to “13.9.2 Analysis Mode Functions” (p. 297), “Octave Filter Characteristics” (p. A24)

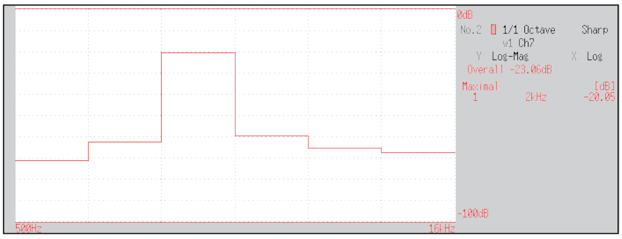
Axis	Display type	Description
X axis	Log	Displays the center frequency of each band.
Y axis	Lin-Mag	Displays octave analysis values linearly.
	Log-Mag(logarithm)	Displays octave analysis values as dB values. (0 dB reference value: 1eu)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

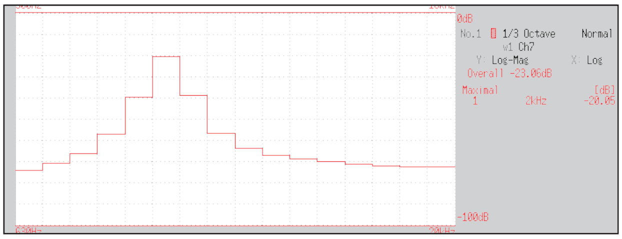
Waveform Example



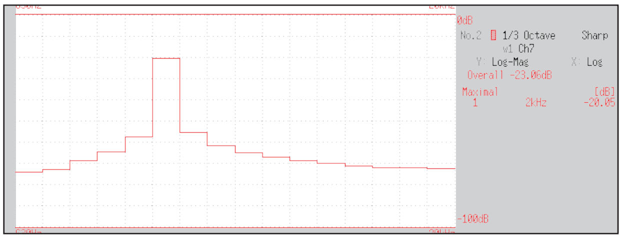
1/1 Octave
X axis: Log
Y axis: Log-Mag
Filter: Normal



1/1 Octave
X axis: Log
Y axis: Log-Mag
Filter: Sharp



1/3 Octave
X axis: Log
Y axis: Log-Mag
Filter: Normal



1/3 Octave
X axis: Log
Y axis: Log-Mag
Filter: Sharp

Not available with external sampling enabled.

■ Octave Analysis

Octave analysis consists of frequency analysis of the signal passed through a constant-width band-pass filter. The power spectrum displays the power level in each subband after dividing the spectrum into fixed-width segments (subbands), while octave analysis scales the spectrum logarithmically and displays each octave (subband) as a bar graph.

The center frequency of the octave bands and filter characteristics are determined according to IEC61260 standards. 1/1- and 1/3-octave analyses are calculated using power spectrum Analysis results.
1/1 Octave Analysis: 6 subbands
1/3 Octave Analysis: 16 subbands

The octave analysis results of this unit are displayed based on the oscillation level as a reference. Therefore, when only sine waves are input, the value doubles (3.01 dB) versus the overall value. To directly read by energy base, adjust the level by the setting scaling in advance.
Refer to “8.5 Convert Input Values (Scaling Function)” (p. 157).

Measurable Ranges With Octave Analysis

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1μ	2μ	5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1.2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3.33	2	1.66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1.33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
-8	-24	4m																										●
	-23	5m																										○
-7	-22	6.3m																										○
	-21	8m																									●	○ ●
	-20	10m																									○	○
-6	-19	12.5m																								○	○	○
	-18	16m																							●	○ ●	○ ●	○ ●
	-17	20m																							○	○	○	○
-5	-16	25m																						○	○	○	○	○
	-15	31.5m																					●	○ ●	○ ●	○ ●	○ ●	○ ●
	-14	40m																					○	○	○	○	○	○
-4	-13	50m																					○	○	○	○	○	○
	-12	63m																					○ ●	○ ●	○ ●	○ ●	○ ●	○ ●
	-11	80m																					○	○	○	○	○	○
-3	-10	100m																					○	○	○	○	○	○
	-9	125m																				○ ●	○ ●	○ ●	○ ●	○ ●	○ ●	○ ●
	-8	160m																				○	○	○	○	○	○	○
-2	-7	200m																				○	○	○	○	○	○	
	-6	250m																			○ ●	○ ●	○ ●	○ ●	○ ●	○ ●	○ ●	
	-5	315m																			○	○	○	○	○	○	○	
-1	-4	400m																			○	○	○	○	○	○		
	-3	500m																		●	○ ●	○ ●	○ ●	○ ●	○ ●	●		
	-2	630m																		○	○	○	○	○	○			
0	-1	800m																		○	○	○	○	○				
	0	1																	●	○ ●	○ ●	○ ●	○ ●	●				
	1	1.25																	○	○	○	○	○					
1	2	1.6																	○	○	○	○						
	3	2																●	○ ●	○ ●	○ ●	○ ●						
	4	2.5																○	○	○	○	○						
2	5	3.15																○	○	○	○	○						
	6	4																○ ●	○ ●	○ ●	○ ●	○ ●						
	7	5																○	○	○	○							
3	8	6.3															○	○	○	○	○							
	9	8															○ ●	○ ●	○ ●	○ ●	○ ●							
	10	10															○	○	○	○								
4	11	12.5														○	○	○	○	○								
	12	16														○ ●	○ ●	○ ●	○ ●	○ ●								
	13	20														○	○	○	○	○								
5	14	25													○	○	○	○	○									
	15	31.5													○ ●	○ ●	○ ●	○ ●	○ ●									
	16	40													○	○	○	○	○									
6	17	50													○	○	○	○										
	18	63												○ ●	○ ●	○ ●	○ ●	○ ●										
	19	80												○	○	○	○	○										

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1μ	2μ	5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1.2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3.33	2	1.66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1.33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
7	20	100												○	○	○	○											
	21	125											● ○	● ○	● ○	● ○	● ○											
	22	160											○	○	○	○	○											
8	23	200											○	○	○	○	○											
	24	250										● ○	● ○	● ○	● ○	● ○	●											
	25	315										○	○	○	○	○												
9	26	400										○	○	○	○	○												
	27	500									●	● ○	● ○	● ○	● ○	●												
	28	630									○	○	○	○	○													
10	29	800									○	○	○	○	○													
	30	1k								●	● ○	● ○	● ○	● ○	●													
	31	1.25k								○	○	○	○	○														
11	32	1.6k								○	○	○	○	○														
	33	2k							●	● ○	● ○	● ○	● ○	● ○														
	34	2.5k							○	○	○	○	○															
12	35	3.15k							○	○	○	○	○															
	36	4k							● ○	● ○	● ○	● ○	● ○															
	37	5k							○	○	○	○																
13	38	6.3k						○	○	○	○	○																
	39	8k						● ○	● ○	● ○	● ○	● ○																
	40	10k						○	○	○	○																	
14	41	12.5k					○	○	○	○	○																	
	42	16k					● ○	● ○	● ○	● ○	● ○																	
	43	20k					○	○	○	○	○																	
15	44	25k				○	○	○	○	○																		
	45	31.5k				● ○	● ○	● ○	● ○	● ○																		
	46	40k				○	○	○	○	○																		
16	47	50k				○	○	○	○																			
	48	63k			● ○	● ○	● ○	● ○	● ○																			
	49	80k			○	○	○	○	○																			
17	50	100k			○	○	○	○																				
	51	125k		● ○	● ○	● ○	● ○	● ○																				
	52	160k		○	○	○	○	○																				
18	53	200k		○	○	○	○	○																				
	54	250k	● ○	● ○	● ○	● ○	● ○	●																				
	55	315k	○	○	○	○	○																					
19	56	400k	○	○	○	○	○																					
	57	500k	● ○	● ○	● ○	● ○	●																					
	58	630k	○	○	○	○																						
20	59	800k	○	○	○	○																						
	60	1M	● ○	● ○	● ○	●																						
	61	1.25M	○	○	○																							
21	62	1.6M	○	○	○																							
	63	2M	● ○	● ○	● ○																							
	64	2.5M	○	○																								

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1μ	2μ	5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1.2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3.33	2	1.66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1.33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
22	65	3.15M	○	○																								
	66	4M	● ○	● ○																								
	67	5M	○																									
23	68	6.3M	○																									
	69	8M	● ○																									
	70	10M																										
24	71	12.5M																										

13.9.2 Analysis Mode Functions

Analysis mode	Internal analysis formula (linear, real, imag [imaginary], log [logarithm])
OFF	No analysis
Storage Waveform	Waveform obtained by applying the window function to a time-domain waveform
Histogram	Counts amplitude data
Linear Spectrum	$X(k) = \sum_{n=0}^{N-1} x(n)W^{kn}$ $F(k) = CX(k)$ $C\begin{cases}1/N(DC)\\2/N(AC)\end{cases}$ $linear = \lvert F(k)\rvert$ $real = \mathrm{Re}\{F(k)\}$ $imag = \mathrm{Im}\{F(k)\}$ $\log = 20\log\lvert F(k)\rvert$
RMS Spectrum	$F'(k) = C'F(k)$ $C'\begin{cases}1 & (DC)\\1/\sqrt{2}(AC)\end{cases}$ $linear = \lvert F'(k)\rvert$ $real = \mathrm{Re}\{F'(k)\}$ $imag = \mathrm{Im}\{F'(k)\}$ $\log = 20\log\lvert F'(k)\rvert$
Power Spectrum	$P(k) = a\lvert F(k)\rvert^2$ $a = \begin{cases}1 & (DC)\\1/2\ (AC)\end{cases}$ $linear = P(k)$ $\log = 10\log\lvert P(k)\rvert$
Power Spectrum Density	$P'(k) = P(k)/\delta f$ δf: Frequency resolution $linear = P'(k)$ $\log = 10\log\lvert P'(k)\rvert$
LPC analysis (Power Spectrum Density)	(Omission) Spectrum approximation from Linear Predictive Coding Refer to "Linear Time-Invariant Systems" (p. A14).
Transfer Function	$H(k) = Y(k)/X(k)$ $linear = \lvert H(k)\rvert$ $real = \mathrm{Re}\{H(k)\}$ $imag = \mathrm{Im}\{H(k)\}$ $\log = 20\log\lvert H(k)\rvert$
Cross Power Spectrum	$S_{yx}(k) = X^*(k)Y(k)$: Cross spectrum $X_{power}(k) = AS_{yx}(k)$ $A = \begin{cases}1/N^2\\2/N^2\end{cases}$ $linear = \lvert X_{power}(k)\rvert$ $real = \mathrm{Re}\{X_{power}(k)\}$ $imag = \mathrm{Im}\{X_{power}(k)\}$ $\log = 10\log\lvert X_{power}(k)\rvert$
Impulse Response	$h(n) = \frac{1}{N}\sum_{k=0}^{N-1}\frac{Y(k)}{X(k)}W^{-kn}$
Coherence Function	$coh(k) = \sqrt{\frac{S_{yx}(k)S_{yx}^*(k)}{S_{xx}(k)S_{yy}(k)}}$
Phase Spectrum	$\theta(k) = 180/\pi \times \tan^{-1}(\mathrm{Im}(F'(k))/\mathrm{Re}(F'(k))$ $\theta(k) = 180/\pi \times \tan^{-1}(\mathrm{Im}(S_{yx}(k))/\mathrm{Re}(S_{yx}(k))$
Auto-correlation Function	$R_{xx}(n) = \frac{1}{N}\sum_{k=0}^{N-1}\lvert X(k)\rvert^2 W^{-kn}$ (recursive convolution)
Cross-correlation Function	$R_{yx}(n) = \frac{1}{N}\sum_{k=0}^{N-1}S_{yx}(k)W^{-kn}$ (recursive convolution)
1/1 Octave Analysis	(Omission)
1/3 Octave Analysis	(Omission)

14 Waveform Evaluation Function

14.1 Waveform GO/NG Evaluation (MEM, FFT Function)

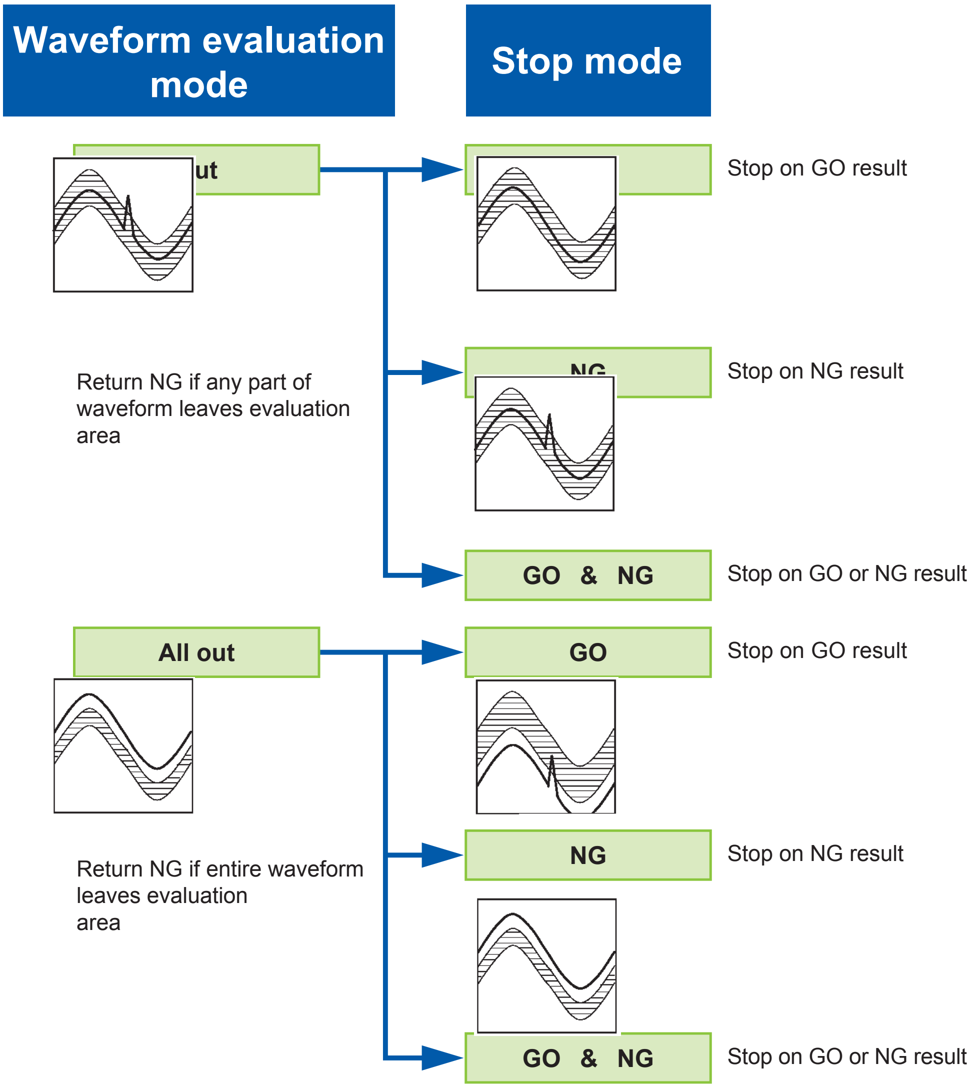
The waveform evaluation function can be used from the Memory function (single screen, X-Y single screen), FFT function (1 screen standard, 1 screen Nyquist).
GO (pass) or NG (fail) evaluation of the input signal waveform can be performed using an evaluation area specified by the user. This can detect irregular waveforms. Depending on evaluation results, signals will be output on the external control terminals.
All channels being displayed can be used for GO/NG evaluation.

Setting Workflow (After the Input and Other Settings Have Been Finished)

Set the evaluation area	**Load**	Load a previously created evaluation area and settings from the File screen.
	Create a new area	Create an evaluation area using the eight edit commands. Store the evaluation area in memory, then store the data on storage media on the File screen.
Set waveform evaluation	**OFF**	Disable waveform evaluation.
	OUT	Return NG if any part of the waveform leaves the evaluation area.
	ALL OUT	Return NG if the entire waveform leaves the evaluation area.
Set GO/NG stop mode	**GO**	Stop recording on GO result.
	NG	Stop recording on NG result.
	GO & NG	Stop recording on GO or NG result.
Measurement starts		Press the **START** key to start measurement. Data acquisition will start when the trigger conditions are met.
Execute waveform GO/NG evaluation		Once the evaluation process is complete, the result will be output as the signals from the external control terminals. If the evaluation result satisfies the stop conditions, automatic saving and automatic printing will be performed, if enabled. When using memory segmentation, the same block is repeatedly measured as long as the stop conditions are not satisfied. Once the stop conditions are satisfied, measurement moves to the next block.

- Trigger mode: **[Single]** Measurement continues until stop mode conditions are fulfilled, then stops.
- Trigger mode **[Repeat]**, **[Auto]** Recording and waveform evaluation is carried out continuously. Press the **STOP** key to stop measurement.
- When “Auto-print” is **[On]**, the waveform is printed when the stop conditions are satisfied.
- When “Auto-save” is **[On]**, the data is saved into the media when the stop conditions are satisfied.
- When “Memory Div” is **[On]**, data is recorded to the memory block only when the stop conditions are satisfied.
- The waveform evaluation is performed concurrently with measurement when “Roll Mode” is **[On]** and the timebase is slow as 100 ms/div or less, or when the “Roll Mode” is **[Auto]** and the display is 100 ms/div or less due to the time axis magnification. Otherwise, the evaluation is performed after measurement.
- When performing evaluation after measurement is complete, data capture and evaluation alternate repeatedly. Data is not captured while the evaluation is in progress. This means that the input signal is not being continuously monitored. The time required for evaluation is on the order of 100 ms, not including time required to read data or update the display.
- When performing evaluation and measurement concurrently, measurement continues while the waveform is displayed and evaluated. However, processing is not necessarily conducted in real time.
- If a high setting is chosen for recording length or if compression is used, the evaluation cycle becomes slower.
- Waveform scrolling is not available while “Waveform Judge” is ON (**[Out]** or **[All out]**). To use waveform scrolling, first turn off “Waveform Judge”.
- When memory function waveform evaluation is specified, one screen of display data (25 divisions) is printed out. When you need to print waveform data with a recording length longer than 25 divisions, first set “Waveform Judge” to **[Off]**.
- Although the waveform display will change if you change display-related settings after measurement completes, the waveform evaluation results from when the measurement was made will be retained. To repeat the evaluation process for the waveform after applying new settings, perform waveform evaluation on the Status basic settings screen.
  Refer to “7.5.1 Magnify and Compress Horizontal Axis (Time Axis)” (p. 136).
- When using the highlight function with the FFT function, only the highlighted data is evaluated.

Waveform Evaluation Mode and Stop Mode



Return NG if any part of waveform leaves evaluation area

Return NG if entire waveform leaves evaluation area

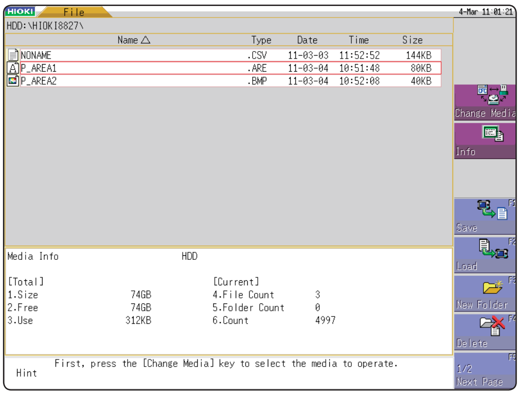
14.2 Set the Waveform Area

An evaluation area is required to evaluate waveforms. Two methods are available: one is to load a previously created evaluation area and settings, and the other is to create a new evaluation area.

Loading the Previously Created Evaluation Area

Setting method

Setting screen: File



HDD:\HIOKI8827\

Name △	Type	Date	Time	Size
NONAME	.CSV	11-03-03	11:52:52	144KB
P_AREA1	.ARE	11-03-04	10:51:48	80KB
P_AREA2	.BMP	11-03-04	10:52:08	40KB

Media Info HDD

[Total]		[Current]	
1.Size	74GB	4.File Count	3
2.Free	74GB	5.Folder Count	0
3.Use	312KB	6.Count	4997

Hint First, press the [Change Media] key to select the media to operate.

1. **Press the FILE key to open the File screen.**
2. **Select the [Media] from which to load.**
3. **Use the bar cursor to select the desired file.**
4. **Select a command.**

   Select **[Load]**.
5. **Choose [Exec] from the F key menu.**
6. **When no more changes need be made to the loaded settings, press the DISP key to make the Waveform display screen appear, and then press the START key to initiate measurement.**

   To change the settings, first change the contents, press the **DISP** key to make the Waveform display screen appear, and then press the **START** key to initiate measurement.

   Refer to “5.3 Load Data” (p. 99).

Requirements for loading waveform evaluation area BMP files

Observe the following requirements when creating waveform evaluation areas on a PC and when loading waveform evaluation areas created on other equipment:

Items	Condition	Loading operation
Color	Black and white	White pixels are treated as background. Black pixels are treated as the evaluation area.
Size	501 horizontal pixels × 626 vertical pixels	The file will be used as the evaluation area for the Memory Function 1 screen.
	501 horizontal pixels × 501 vertical pixels	When using the FFT function, the file will be used as the FFT evaluation area. When using other functions, the file will be used as the memory function XY evaluation area.

Files that do not satisfy these requirements cannot be loaded properly.

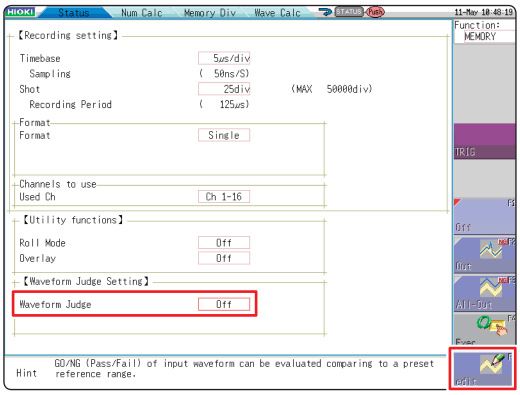
Creating a New Evaluation Area

Setting method

Setting screen: Status

1. **Press the STATUS key to display the Status screen.**
2. **Move the flashing cursor to [Waveform Judge].**
3. **Choose [edit] from the F key menu.**
4. **Activate editor to set up the evaluation area.**
   Refer to “14.5 Create the Evaluation Area” (p. 307).
5. **Store the created area in memory.**
6. **After setting “Waveform Judge setting” and “Stop Mode,” press the DISP key to show the Waveform display screen, then press the START key to begin measurement.**
7. **Save the evaluation area on the File screen, if necessary.**
   Refer to “5.2 Save Data” (p. 87).

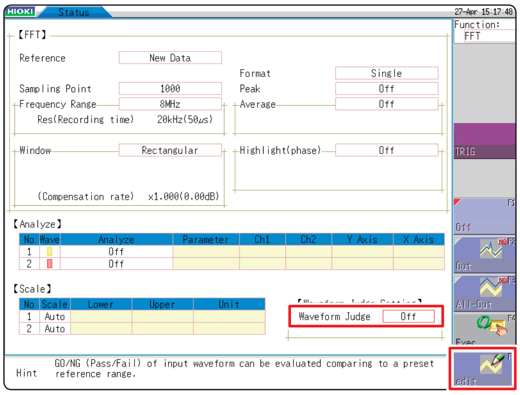
Memory Function



【Recording setting】
Timebase 5µs/div
Sampling (50ns/S)
Shot 25div (MAX 50000div)
Recording Period (125µs)
Format
Format Single
Channels to use
Used Ch Ch 1-16
【Utility functions】
Roll Mode Off
Overlay Off
【Waveform Judge Setting】
Waveform Judge Off

Hint GO/NG (Pass/Fail) of input waveform can be evaluated comparing to a preset reference range.

FFT Function



【FFT】
Reference New Data
Format Single
Sampling Point 1000
Peak Off
Frequency Range 8MHz
Average Off
Res(Recording time) 20kHz(50µs)
Window Rectangular
Highlight(phase) Off
(Compensation rate) x1.000(0.00dB)

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

【Waveform Judge Setting】
Waveform Judge Off

Hint GO/NG (Pass/Fail) of input waveform can be evaluated comparing to a preset reference range.

> Only one waveform evaluation area may be stored in internal memory.
> For example, when operation is changed from the Memory function screen to the X-Y screen and an X-Y screen waveform evaluation area is stored, a waveform evaluation area created for the Memory function will be lost.

14.3 Set the Waveform Evaluation Mode

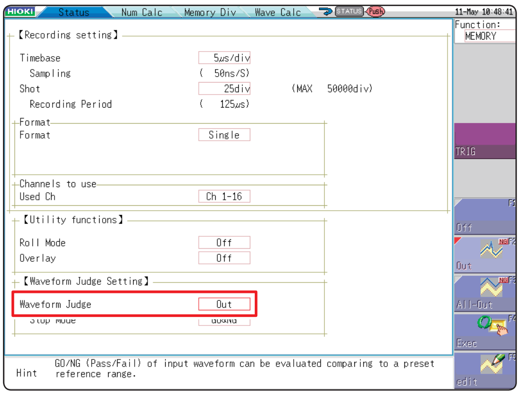
Setting method

Setting screen: Status

1. **Move the flashing cursor to [Waveform Judge].**
2. **Choose the required setting from the F key menu.**

Off	Disable waveform evaluation.
Out	Return NG if any part of the waveform leaves the evaluation area.
All out	Return NG if the entire waveform leaves the evaluation area.
exec	Enable waveform evaluation.
edit	Activate editor to set up the evaluation area.

Memory Function



【Recording setting】

Timebase 5µs/div

Sampling (50ns/S)

Shot 25div (MAX 50000div)

Recording Period (125µs)

Format

Format Single

Channels to use

Used Ch Ch 1-16

【Utility functions】

Roll Mode Off

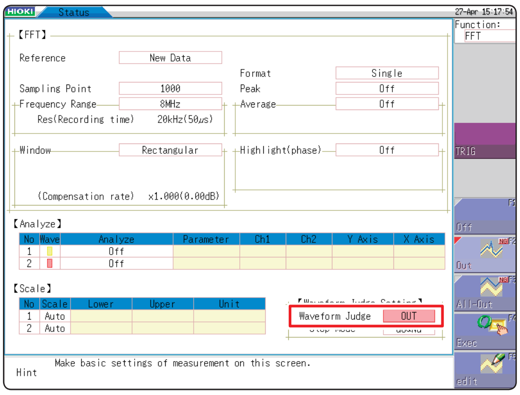
Overlay Off

【Waveform Judge Setting】

Waveform Judge Out

Hint GO/NG (Pass/Fail) of input waveform can be evaluated comparing to a preset reference range.

FFT Function



【FFT】

Reference New Data

Format Single

Sampling Point 1000

Peak Off

Frequency Range 8MHz

Average Off

Res(Recording time) 20kHz(50µs)

Window Rectangular

Highlight(phase) Off

(Compensation rate) x1.000(0.00dB)

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

Waveform Judge OUT

Hint Make basic settings of measurement on this screen.

14.4 Set Waveform Evaluation Stop Mode

When waveform evaluation is enabled (Out or All out is selected), the "Stop mode" menu appears. Specify which evaluation option, GO or NG, should be used to stop the recording.
The auto-save and auto-print functions are only executed when interruption conditions are satisfied.

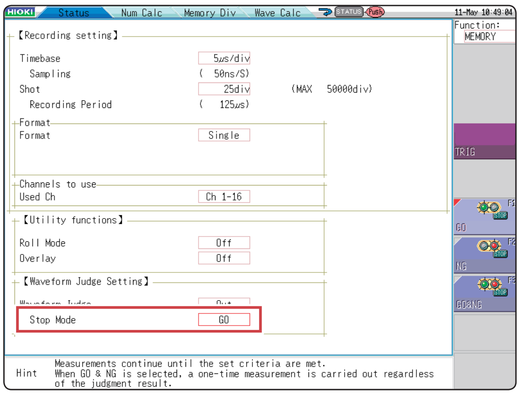
Setting method

Setting screen: Status

1 **Move the flashing cursor to [Stop Mode].**

2 **Choose the required setting from the F key menu.**

GO	Stop recording on GO result.
NG	Stop recording on NG result.
GO& NG	Stop recording on GO or NG result.



【Recording setting】
Timebase 5µs/div
Sampling (50ns/S)
Shot 25div (MAX 50000div)
Recording Period (125µs)

Format
Format Single

Channels to use
Used Ch Ch 1-16

【Utility functions】
Roll Mode Off
Overlay Off

【Waveform Judge Setting】
Stop Mode GO

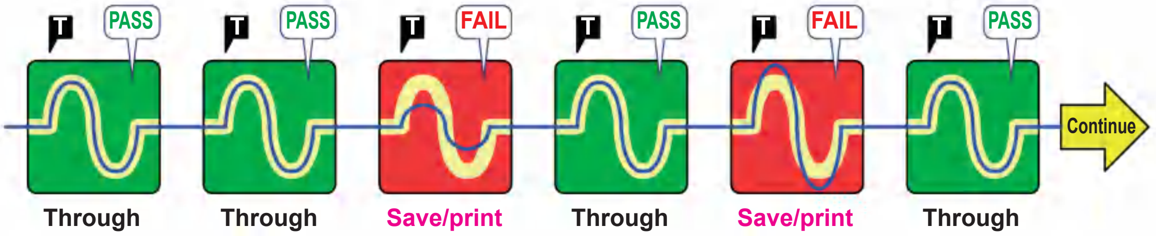
Hint
Measurements continue until the set criteria are met.
When GO & NG is selected, a one-time measurement is carried out regardless of the judgment result.

Relationship Between Stop Conditions and Trigger Mode

- There are three trigger modes: Single, Repeat, and Auto.
  Refer to “9.2 Set the Trigger Mode” (p. 197).
- There are three stop conditions: GO (Pass), NG (Fail), and GO&NG (Pass & Fail)
- By combining a trigger mode and a stop condition, you can halt measurement when the desired comparison result is achieved. You can also automatically save, automatically print, or superimpose the waveform for the desired evaluation results.
  Automatic saving, automatic printing, and superimposition are performed when the stop conditions are met.

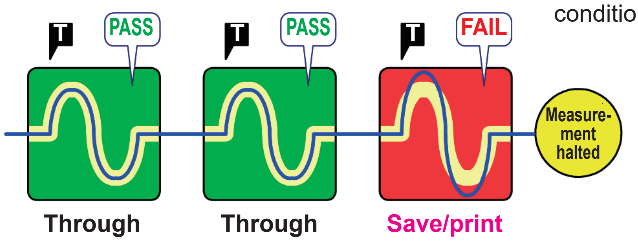
In case of “Repeat” trigger mode and “NG” stop condition.

Measurement continues until the user presses the STOP key.
Auto-save and auto-print is initiated only when the stop conditions are met.



In case of “Single” trigger mode and “NG” stop condition.

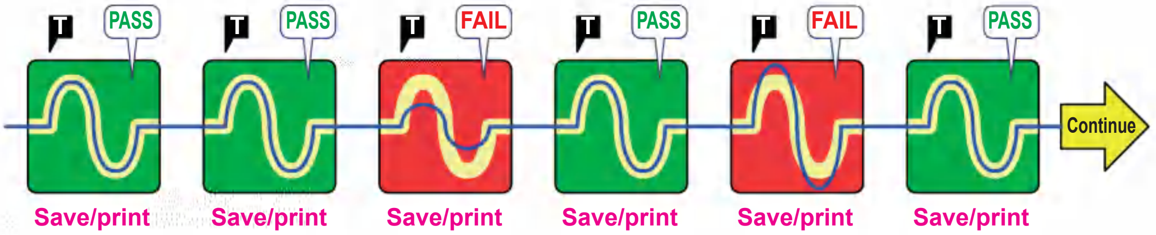
Measurement halts when a “FAIL” comparison result is returned.
Auto-save and auto-print is initiated only when the stop conditions are met.



Measurement halted because stop conditions are met.

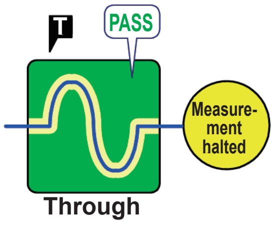
In case of “Repeat” trigger mode and “GO & NG” stop condition.

Measurement continues until the user presses the STOP key.
Auto-save and auto-print is initiated each time, regardless of the comparison result

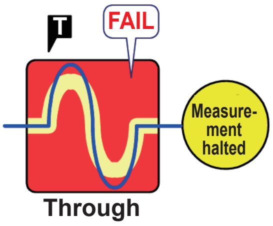


In case of “Single” trigger mode and “GO & NG” stop condition.

Measurement halts after a single operation, regardless of comparison result.
Auto-save and auto-print is initiated regardless of comparison result.



Measurement halted because stop conditions are met.



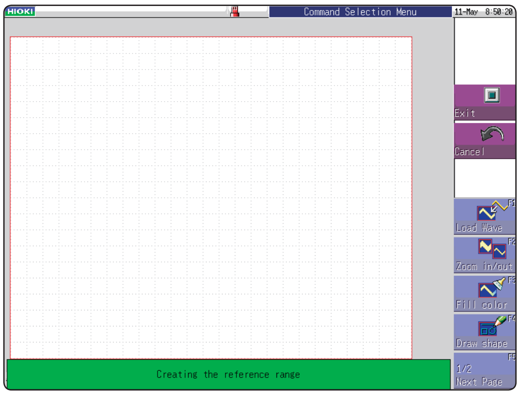
Measurement halted because stop conditions are met.

- When the trigger mode is **[Single]**, the measurement finishes when the stop conditions are fulfilled. The measurement continues until stop conditions are fulfilled.
- When the trigger mode is **[Repeat]** or **[Auto]**, the measurement continues until the **STOP** key is pressed (or the STOP signal is input) regardless of whether the stop conditions are fulfilled or not.

14.5 Create the Evaluation Area

Setting method

Setting screen: Status



Creating the reference range

1 **Move the flashing cursor to the [Waveform Judge] item and select [edit] from the F key menu.**

2 **Select appropriate editors from the F key menu and create an area to be used as the reference for the waveform evaluation.**

You can also use the mouse to create an area.
Refer to "1.4.2 Use a Mouse to Perform Key Operations" (p. 25).

3 **Press the F key for [Exit] to exit the editor.**

4 **Store the created area in memory.**

Save and End	Saves the created evaluation area in the instrument's internal memory and exits.
Discard Changes and End	Discards the created evaluation area and exits.

5 **Save the evaluation area through the File screen or SAVE key, if necessary.**

Refer to "5.2 Save Data" (p. 87).

14.6 Editor Command Details

Load Wave

Loads and displays the waveform shown on the Waveform screen in the editor.

Instructions

1. **Press the F key for [Load Wave].**
2. **Select the type of waveform capture to perform. The waveform displayed on the Waveform screen will be loaded into the editor.**

Waveform capture	Captures the storage waveform displayed on the Waveform screen.
Overlay capture	Captures the overlay waveforms shown on the Waveform screen, then connects the uppermost and lowermost positions with the same display color and fills in the resulting enclosed space. When the waveforms overlap, portions of the waveforms that are not displayed cannot be recognized. This option can be selected when an overlay has been drawn on the screen.
Memory segmentation reference waveform	Captures the memory segmentation reference waveform shown on the Waveform screen, then connects the uppermost and lowermost positions with the same display color and fills in the resulting enclosed space. When the waveforms overlap, portions of the waveforms that are not displayed cannot be recognized. This option can be selected when a memory segmentation reference waveform has been drawn on the screen.

3. **Press the F key for [Load Wave] to exit waveform capture mode.**

Zoom in/out

Magnifies or compresses the waveform shown on the screen in the horizontal and vertical directions.

Instructions

1. **Press the F key for [Zoom in/out].**
2. **Select whether to magnify or compress the waveform.**
3. **Set the amount of magnification or compression.**
   - You can set values with the F keys, jog knob, or shuttle knob.
   - The amount of movement can be set in 0.04 div steps.

Execute	Performs magnification or compression processing based on the settings and creates an evaluation area.
Exit magnification/ compression	Exits magnification/compression mode.

Fill color

Fills in an enclosed area.

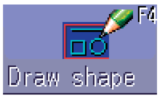
Instructions

1 **Press the F key for [Fill color].**

2 **Use the cursor keys to move the paintbrush ⊞ mark to the area to be filled in.**

Press **[Speed up]** to accelerate the movement of the mark.
If the area is not completely enclosed, adjacent areas will also be filled in.

Execute	The area completely enclosed by lines is filled in.
Exit paint	Exit paint mode.



Draw shape

Draw a line, square or circle.

Instructions

1 **Press the F key for [Draw shape].**

2 **Select the figure you wish to draw.**

3 **Use the cursor keys to move the ⊞ mark to the origin of the figure.**

Press **[Speed up]** to accelerate the movement of the mark.

4 **Press the F key for [Set].**

The origin is set at the current position.

5 **Move the ⊞ mark.**

A figure is drawn between the origin and the ⊞ mark.

6 **Press [Set] again.**

The color of the figure changes and the figure is confirmed.
For straight lines, the origin is set at the accepted position.
For other types of figure, accepting the figure has the same effect as pressing **[Cancel]**.

7 **To draw another figure, press [Select] and select the figure type.**

8 **Repeat steps 3 through 7 to draw figures as desired.**

9 **Press the [Exit Draw shape] key to exit figure mode.**

Eraser

Erase unwanted sections. Move the ☒ mark with the cursor keys to erase parts of the image.

Instructions

1. **Press the F key for [Eraser].**
2. **Using the cursor keys, move the ☒ mark to the origin of the area to be erased.**
   Press **[Speed up]** to accelerate the movement of the mark.
3. **Press the F key for [Set].**
   Now you can erase figures by moving the eraser. Press the **F** key for **[Cancel]** and you can move the eraser without erasing figures.
4. **Move the ☒ mark in the [Set] state to erase the parts of figures you do not need.**
5. **Press the [Exit Erase] key to exit erase mode.**

Clear all

Clears the entire editor screen.

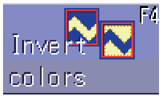
Press the F key for [Clear all].
The editor screen is cleared.

Clear select area

Clears a specified rectangular area of the editor screen.

Instructions

1. **Press the F key for [Clear select area].**
2. **Using the cursor keys, move the ⊞ mark to the origin of the area to be erased.**
   Press **[Speed up]** to accelerate the movement of the mark.
3. **Press the [Set] function key to set the position as the origin.**
4. **Move the ⊞ mark.**
   A rectangle is drawn between the origin and the ⊞ mark.
5. **Press [Set] again.**
   The area inside the rectangle is erased. Press **[Cancel]** and the position of the origin is canceled.
6. **Press the F key for [Exit Area Clear] to exit from the area clear mode.**



Invert colors

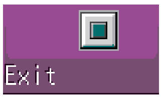
Reverses the colors of a filled-in area and the surrounding area.

Press the F key for [Invert colors].
The filled in area is displayed in reverse.

Cancel

Undo the last executed command.
Undo can be used with any command other than **[Save and End]** and **[Discard and End]**.

Press the F key for [Cancel].



Exit

Exits the editor.

Instructions

1. **Press the F key for [Exit].**
2. **Select whether to store the evaluation area in memory or discard it before quitting the editor.**

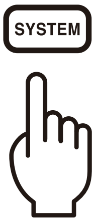
Waveforms loaded into the editor will be displayed in different colors than those set with the original settings.

Save and End	Store evaluation area in memory and quit editor. Refer to “5.2 Save Data” (p. 87).
Discard and End	Quit the editor without storing the evaluation area in memory. The created area is discarded.

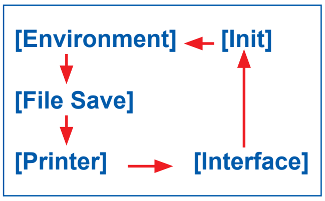
15 System Environment Settings

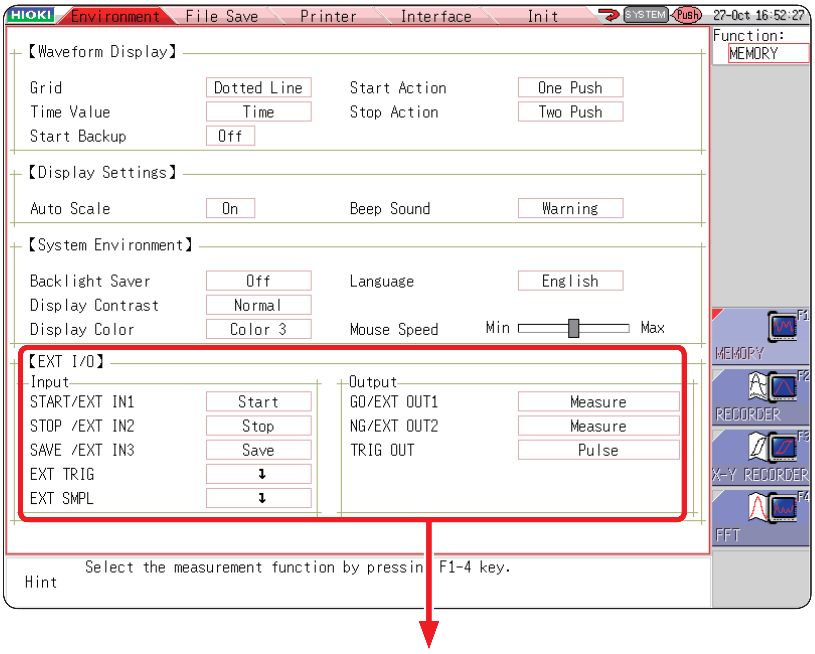
You can set the system environment on the **[Environment]** sheet of the system screen.

To Open the **[Environment]** Sheet



Press this key repeatedly to display the various sheets.





27-Oct 16:52:27

Function: MEMORY

【Waveform Display】

Grid: Dotted Line
Time Value: Time
Start Backup: Off
Start Action: One Push
Stop Action: Two Push

【Display Settings】

Auto Scale: On
Beep Sound: Warning

【System Environment】

Backlight Saver: Off
Display Contrast: Normal
Display Color: Color 3
Language: English
Mouse Speed: Min — Max

【EXT I/O】

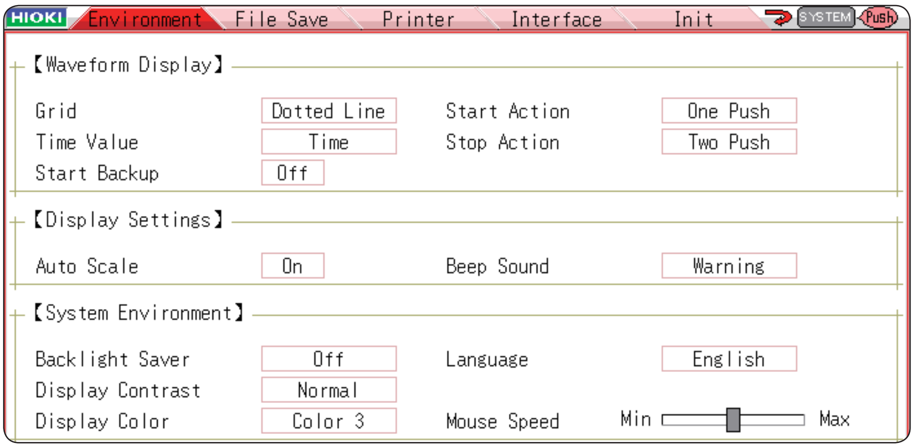
Input
START/EXT IN1: Start
STOP /EXT IN2: Stop
SAVE /EXT IN3: Save
EXT TRIG: ↓
EXT SMPL: ↓

Output
GO/EXT OUT1: Measure
NG/EXT OUT2: Measure
TRIG OUT: Pulse

Hint: Select the measurement function by pressin F1-4 key.

Refer to “17 External Control” (p. 343).

Setting Descriptions



【Waveform Display】

Grid: Dotted Line
Time Value: Time
Start Backup: Off
Start Action: One Push
Stop Action: Two Push

【Display Settings】

Auto Scale: On
Beep Sound: Warning

【System Environment】

Backlight Saver: Off
Display Contrast: Normal
Display Color: Color 3
Language: English
Mouse Speed: Min – Max

Grid

Select the grid (graticule) type for the waveform screen.

Off	No grid displayed.
Dotted Line	Display a dotted-line grid. *(Default setting)*
Solid Line	Display a solid-line grid.

Time Value

Display the time from the trigger point on the display.

Time	Display the time from the trigger point (unit is fixed). *(Default setting)*
Time (60)	Display the time from the trigger point (sexagesimal (base-60) system).
div	Display the number of divisions (div) from the trigger point.
Date	Display time of waveform acquisition.
Sample Num	Display the number of data points from the trigger point.

- During external sampling, the number of points is fixed.
- These settings affect the values read at the AB cursors.

Start Backup

Preserves measurement condition settings. If the power is turned off during recording due to power outage or other reasons, the operation resumes automatically when the power is restored.
When triggering is enabled, the awaiting-trigger state is activated.

Off *(Default setting)*/On

- Valid only during recording.
- This function does not start automatically when the instrument is turned on.

Backlight Saver

The screen blanks automatically after the specified period (minutes) with no key operation. The screen reappears when any key is pressed.

Off	Disables the backlight saver function. *(Default setting)* The screen remains visible at all times.
(Setting the time)	Setting range: 1 to 30 min (in whole minutes)

- When the screen is blanked by the backlight saver, pressing a key only reactivates the backlight; the normal key function is ignored. Press the key again for its normal function.
- Using the backlight saver conserves energy and extends the life of the backlight.

Display Contrast

Selects one of three backlight brightness levels.

Light / Normal / Dark

Display Color

Screen background and character colors on the Waveform screen can be set as desired. Select **[Color Edit]** then change the **[R]** (red), **[G]** (green) and **[B]** (blue) values of each item to change its color. (p. 316)

Color 1 / Color 2 / Color 3 / Color Edit

Beep Sound

This function audibly indicates warnings and operating conditions with beeps.

Off	Beep are disabled.
Warning	Beeps for error messages (warning displays) and NG (fail) judgments. *(Default setting)*
Warn+Act	In addition to the warning beeps above, beeps to indicate start, trigger, stop and auto-save-finish.

Language

Selects the display language.

English *(Default setting)*/ Japanese / Korean / Chinese

Auto Scale

Variable values are automatically changed according to changes in scaling and voltage range.
Refer to “8.6 Set the Waveform Position (Variable Function)” (p. 164).

Off/On *(Default setting)*

Start Action

To prevent operation mistakes from unintentionally starting measurement, the **START** key operation method can be changed. This setting does not affect external control terminal functions.

One Push	Measurement starts with on press. *(Default setting)*
Two Push	Measurement starts with two presses.
Hold 2s*	Measurement starts when pressed and held for two seconds.

* When the **START** key is pressed, “Hold START key down.” will be displayed. After pressing for two seconds, the message disappears and measurement starts.

Stop Action

Normally, pressing the **STOP** key once causes measurement to stop after the specified recording length is completed, and pressing it twice stops measurement immediately. This setting is provided to allow a single press to stop measurement.

Two Push	Press the key twice to stop measurement. *(Default setting)*
One Push	Press the key once to stop measurement.

Mouse Speed

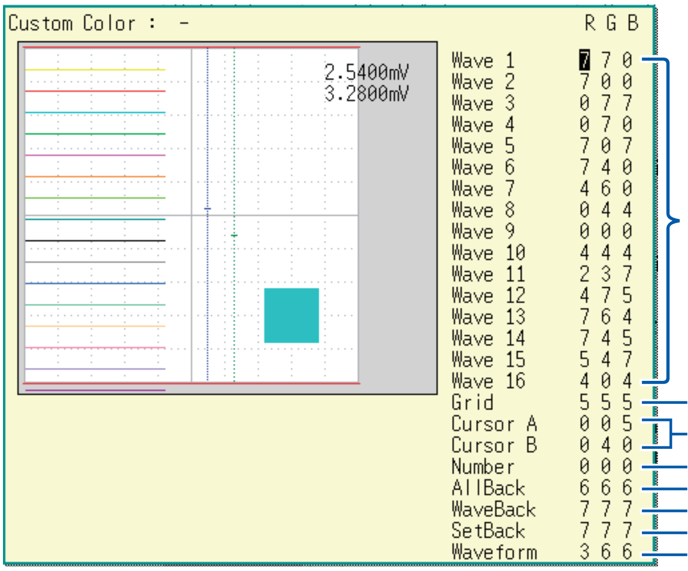
Sets the mouse movement speed.
Use the mouse to move the slider handle while holding down the left mouse button.
Sliding it towards “Min” makes the mouse pointer move more slowly slowly, while sliding it towards “Max” makes the pointer move more quickly.

Additional Description

Select a Screen Color

Select **[Color Edit]** to display the [Custom Color] screen.
Change the **[R]** (red), **[G]** (green) and **[B]** (blue) values of each item to change its color.
Refer to “8.1.3 Alphanumeric Input” (p. 149).

[Custom Color] screen



```
Custom Color : -                      R G B
                           Wave 1     7 7 0
                           Wave 2     7 0 0
                           Wave 3     0 7 7
                           Wave 4     0 7 0
                           Wave 5     7 0 7
                           Wave 6     7 4 0
                           Wave 7     4 6 0
                           Wave 8     0 4 4
                           Wave 9     0 0 0
                           Wave 10    4 4 4
                           Wave 11    2 3 7
                           Wave 12    4 7 5
                           Wave 13    7 6 4
                           Wave 14    7 4 5
                           Wave 15    5 4 7
                           Wave 16    4 0 4
                           Grid       5 5 5
                           Cursor A   0 0 5
                           Cursor B   0 4 0
                           Number     0 0 0
                           AllBack    6 6 6
                           WaveBack   7 7 7
                           SetBack    7 7 7
                           Waveform   3 6 6
```

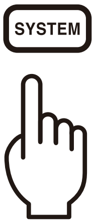
Color setting for each waveform
Grid (graticule) color
Colors of cursor A and B lines
Color of numerical values
Background color
Background color of the Waveform screen
Background color of the setting screen
Evaluation area color

Done	Applies the settings.
Reset	Reverts to the default settings.

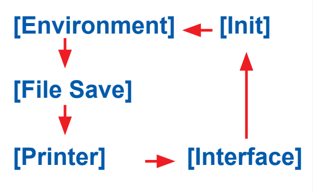
16 Connect to a PC

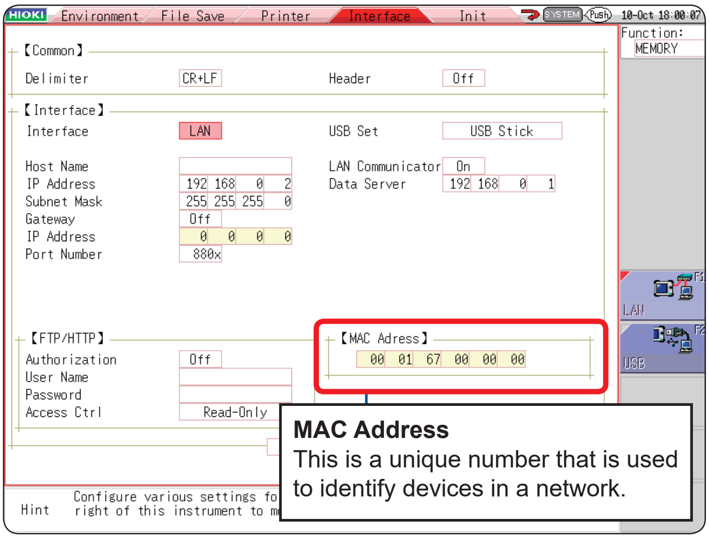
This instrument is equipped with an Ethernet 100BASE-TX interface for LAN communications.
You can control the instrument from PCs and other devices by connecting it to a network with 10BASE-T or 100BASE-TX cable (maximum length 100 m). It is also possible to directly connect the instrument to a PC via USB.

To Open the [Interface] sheet



Press this key repeatedly to display the various sheets.


[Environment] ← [Init]
↓ ↑
[File Save]
↓
[Printer] → [Interface]



Function: MEMORY

【Common】
Delimiter CR+LF
Header Off

【Interface】
Interface LAN
USB Set USB Stick
Host Name
IP Address 192 168 0 2
Subnet Mask 255 255 255 0
Gateway Off
IP Address 0 0 0 0
Port Number 880x
LAN Communicator On
Data Server 192 168 0 1

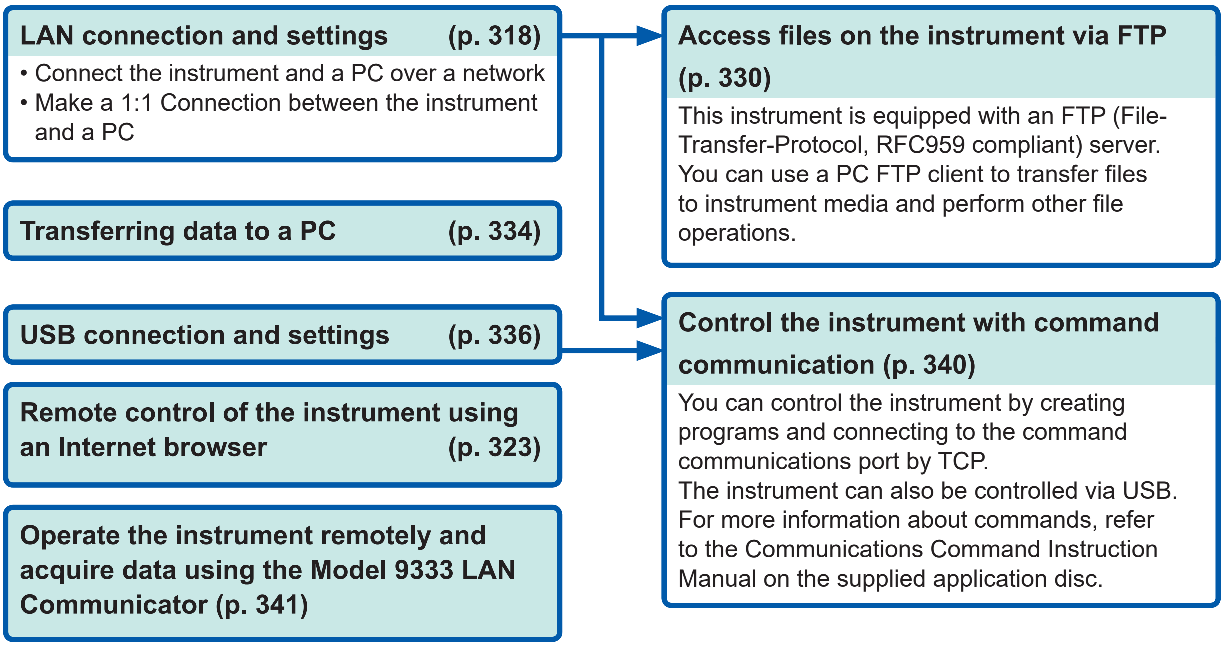
【FTP/HTTP】
Authorization Off
User Name
Password
Access Ctrl Read-Only

【MAC Adress】
00 01 67 00 00 00

Hint Configure various settings fo
right of this instrument to m

MAC Address
This is a unique number that is used to identify devices in a network.

Operations Available From the [Interface] Sheet



LAN connection and settings (p. 318)
- Connect the instrument and a PC over a network
- Make a 1:1 Connection between the instrument and a PC

Transferring data to a PC (p. 334)

USB connection and settings (p. 336)

Remote control of the instrument using an Internet browser (p. 323)

Operate the instrument remotely and acquire data using the Model 9333 LAN Communicator (p. 341)

Access files on the instrument via FTP (p. 330)
This instrument is equipped with an FTP (File-Transfer-Protocol, RFC959 compliant) server. You can use a PC FTP client to transfer files to instrument media and perform other file operations.

Control the instrument with command communication (p. 340)
You can control the instrument by creating programs and connecting to the command communications port by TCP.
The instrument can also be controlled via USB. For more information about commands, refer to the Communications Command Instruction Manual on the supplied application disc.

16.1 LAN Connection and Settings (Before Using FTP/Internet Browser/Command Communications)

Before accessing the instrument from a PC using FTP or an Internet browser, or using command communication, you must configure the instrument's LAN settings and connect it to your network with a LAN cable.

Always make LAN settings before connecting to the network. If you change settings while connected to the network, IP addresses may overlap or invalid address data may be transmitted over the network.

16.1.1 LAN Settings on the Instrument

Things to Check Before Configuring LAN Settings

The required settings are different depending on whether the instrument is to be connected to an existing network or whether a new network consisting only of the instrument and one PC is to be configured.

When Connecting the instrument to an Existing Network

The following items must be assigned in advance by your network administrator. Be sure there is no conflict with other devices.

- **The host name and address of the instrument**
  Host name (up to 12 characters):
  IP address: .... ___.___.___.___
  Subnet mask: .... ___.___.___.___
- **Gateway**
  Whether to use a gateway: .... Yes/No
  IP address (When used):............. ___.___.___.___
- **The TCP/IP port number to use:** ___X (default 880x)
  Specify the most significant 3 digits of the 4-digit number. The least significant digit (0 to 9) is reserved for use by the instrument.
  Specify when the default value (8800 to 8809) cannot be used.

When Configuring a New Network with a PC and the Instrument

(Use as a local network without external connections)
If there is no administrator for your network, or if you have been entrusted with settings, the following addresses are recommended.

(Example settings)

IP Address
PC: 192.168.0.1
First recorder: 192.168.0.2
Second recorder: 192.168.0.3 and so on, in sequence.
↓ ↓
Host name: Any name (Must be unique)
Subnet mask....................... 255.255.255.0
Gateway .... OFF
Port number......................... 880X

Setting Details

Interface	Select LAN or USB.
Host Name	This name identifies the instrument on the network. Assign an address that is different from the addresses of all other devices. This instrument does not support dynamic DNS. The name that you set is not registered with a DNS server.
IP Address	This address identifies an individual device on a network. Assign an address that is different from the addresses of all other devices.
Subnet Mask	This setting divides an IP address shown to the network into a network address and a host address. Use the same subnet mask for all devices in the same network.
Gateway IP Address	**For network connections** When your PC (or the communicating device) is on another network than this instrument, set this to **[On]** and specify the gateway device. When the PC is on the same network, this is usually set to the same address as the default gateway in the PC communications settings.

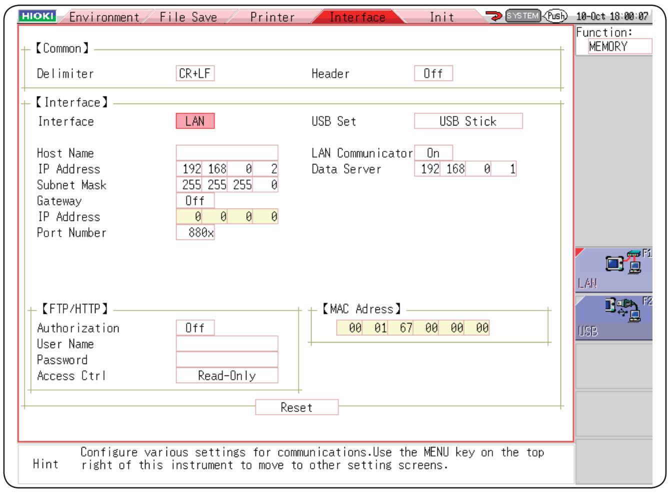
Authorization User Name and Password

These are used when you login to the instrument by FTP, or use a PC Internet browser (When authorization is **[On]**).
When authorization is enabled, login is only possible when a valid user name and password are entered. This setting is recommended if you wish to restrict the users to access the instrument.
The “Password” is displayed as “************”.
Valid characters: Alphabetic characters and symbols (however, “:” (colon) cannot be used)

If you want to allow anyone to access, or you wish to login as “anonymous” with a FTP client, leave the user name and password fields blank.

LAN Setup Workflow

Press the **SYSTEM** key and bring up the **Communications** sheet. Make settings as outlined below to suit your intended use.



【Common】
Delimiter CR+LF
Header Off

【Interface】
Interface LAN
USB Set USB Stick
Host Name
IP Address 192 168 0 2
Subnet Mask 255 255 255 0
Gateway Off
IP Address 0 0 0 0
Port Number 880x
LAN Communicator On
Data Server 192 168 0 1

【FTP/HTTP】
Authorization Off
User Name
Password
Access Ctrl Read-Only

【MAC Adress】
00 01 67 00 00 00

Hint Configure various settings for communications.Use the MENU key on the top right of this instrument to move to other setting screens.

Use the **CURSOR** keys to move the settings cursor and use the **F** keys to select a value for that setting.

Refer to “8.1.3 Alphanumeric Input” (p. 149).

For the details on each setting,
Refer to “Setting Details” (p. 319).

About the network
For IP address information and other details about the network you are using, contact your network administrator.

Intended use	**Connecting the instrument to the existing network**	**Connecting the instrument to the computer directly**
	Connecting the instrument to the network using the specified IP address	
	When you want to name the instrument, set **[Host Name]**.	
Settings when the instrument and the computer connects to the same network	Set **[IP Address]** of the instrument.	Set **[IP Address]** of the instrument.
	Set **[Subnet Mask]**.	Set **[Subnet Mask]**.
Settings when the instrument connects to the different network from the computer network (Useing the gateway)	Set **[Gateway]** to **[On]**	Set **[Gateway]** to **[Off]**
	Set the gateway **[IP Address]**.	
Settings for remote operation and data acquisition using Model 9333 LAN Communicator	Set **[LAN Communicator]** to **[On]**.	Set **[LAN Communicator]** to **[On]**.
	Set IP address of **[Data Server]**.	Set IP address of **[Data Server]**.
Connecting the instrument	Execute **[Reset]**.	Execute **[Reset]**.
	Connect the straight-through cable. Refer to “16.1.2” (p. 318).	Connect the crossover cable. Refer to “16.1.2” (p. 318).

16.1.2 Connect the Instrument to a PC With a LAN Cable

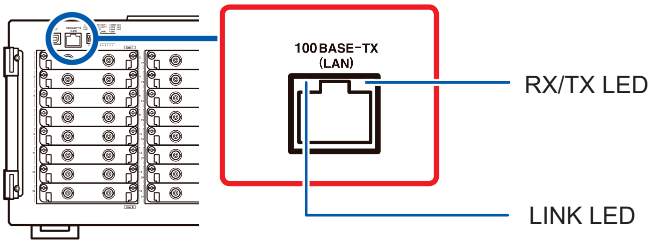
⚠CAUTION

When connecting the instrument to your LAN using a LAN cable of more than 30 m or with a cable laid outdoors, take appropriate countermeasures that include installing a surge protector for LANs. Such signal wiring is susceptible to induced lighting, which can cause damage to the instrument.

Connect the instrument to a PC with a LAN cable as follows.

1 **Plug the LAN cable (100BASE-TX compliant) into the 100BASE-TX connector on the back side of the instrument.**

Back side



RX/TX LED: Flashes while data is being sent or received.

LINK LED: Lights while the instrument is capable of communications with a destination device.

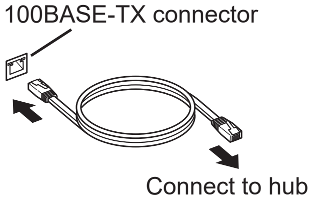
2 **Connect the above LAN cable to the PC.**

There are two ways to do this.

1. Connect the Instrument to a Network
(Connecting the Instrument to a Hub)

You can monitor and control the instrument from a PC by connecting the instrument to a hub with a LAN cable (100BASE-TX cable).

Connection cable: Use one of the following.
- 100BASE-TX straight-through cable (maximum length 100 m, commercially available) (10BASE-T cable may also be used for 10BASE communications)
- 9642 LAN Cable (optional)



Connect the cable to the 100BASE-TX connector on the instrument and hub.

2. Make a 1:1 Connection Between the Instrument and a PC

(Connect the Instrument to a PC)

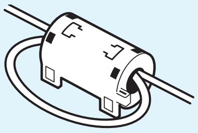
You can monitor and control the instrument from a PC by connecting the instrument to the PC with a LAN cable (100BASE-TX cable)

- Connection cable: Use one of the following.
- 100BASE-TX crossover cable (maximum length 100 m)
- 100BASE-TX straight-through cable (maximum length 100 m)
- 9642 LAN Cable (optional, supplied with crossover adapter)

This completes the connection procedure.

Files on the instrument can now be accessed from the PC.
Refer to “16.2 Perform Remote Operations on the Instrument (Use an Internet Browser)” (p. 323), “16.3 Access Files on the Instrument From a PC (Using FTP)” (p. 330), or “16.7 Controlling the Instrument with Command Communications (LAN/USB)” (p. 340).

If there is a possibility of interference from other equipment in the vicinity, wind the LAN cable once around the supplied ferrite clamp-on choke (for LAN/USB cable), as shown in the illustration at right.



16.2 Perform Remote Operations on the Instrument (Use an Internet Browser)

You can perform remote operations on the instrument from a PC using an Internet browser.

> Attempting to control the instrument simultaneously from multiple PCs may result in unintended operation. Use only one PC to perform remote operations.

To use an Internet browser, the instrument must be properly set up and connected via LAN cable to the PC. (p. 318), (p. 321)
Microsoft® Internet Explorer® 8 or later is recommended. Set the security level to “Medium.” If [REMOTE CONTROL] and [MEMORY DATA GET] do not work, install JRE from the application disc.
Turn off the pop-up blocker.

Installing JRE

1. **Insert the application disc (CD) into the CD-ROM drive.**
   The top page appears automatically.
   If it does not appear, open the “index.htm” file with your Web browser.
2. **Selects the display language.**
   Click the English icon.
3. **Click on the [JRE installation] icon.**
4. **Click on the [Install] icon, then follow the prompts that appear to complete the installation.**

16.2.1 HTTP Settings on the Instrument

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.

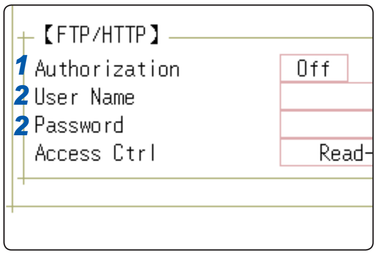
First, set the “LAN Communicator” setting to [Off].

1. **Choose authorization settings.**
   Move the cursor to **[Authorization]**.

Off	Web server authentication not used. (Default setting)
On	Web server authentication used.

2. (When **[On]** is selected)
   Set the user name and password for authentication.
   Move the cursor to **[User Name]** and **[Password]** and enter suitable information.
   Refer to “8.1.3 Alphanumeric Input” (p. 149) or “Authorization User Name and Password” (p. 319).
3. **Apply the settings.**
   Move the cursor to **[Reset].**
   Select **[Reflect Set].**

   The “LAN was reconnected” message will appear at the bottom of the screen.



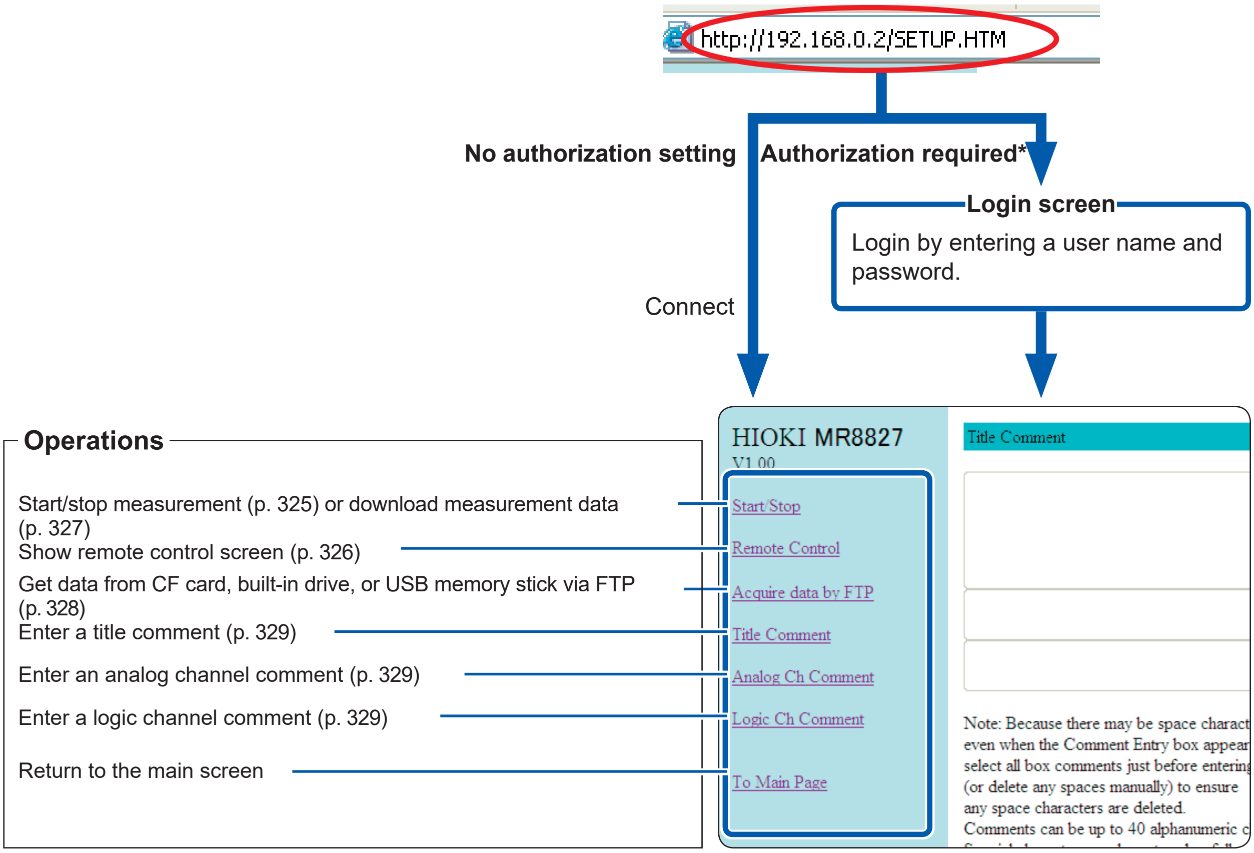
【FTP/HTTP】
1 Authorization Off
2 User Name
2 Password
Access Ctrl Read-

The user name and password for authentication are the same for the Internet browser and for FTP.

16.2.2 Connect to the Instrument With an Internet Browser

The following example shows how to use the Internet Explorer® browser on Windows 7.
Launch Internet Explorer® on the PC and enter “http://” plus the IP address of the instrument in the address bar.

If the IP address of the instrument is “192.168.0.2”



Note: Because there may be space charact
even when the Comment Entry box appear
select all box comments just before entering
(or delete any spaces manually) to ensure
any space characters are deleted.
Comments can be up to 40 alphanumeric c

Operations

- Start/stop measurement (p. 325) or download measurement data (p. 327)
- Show remote control screen (p. 326)
- Get data from CF card, built-in drive, or USB memory stick via FTP (p. 328)
- Enter a title comment (p. 329)
- Enter an analog channel comment (p. 329)
- Enter a logic channel comment (p. 329)
- Return to the main screen

* When user name and password for authentication were set via System screen - **[Interface]** sheet.
Refer to “16.2.1 HTTP Settings on the Instrument” (p. 323).

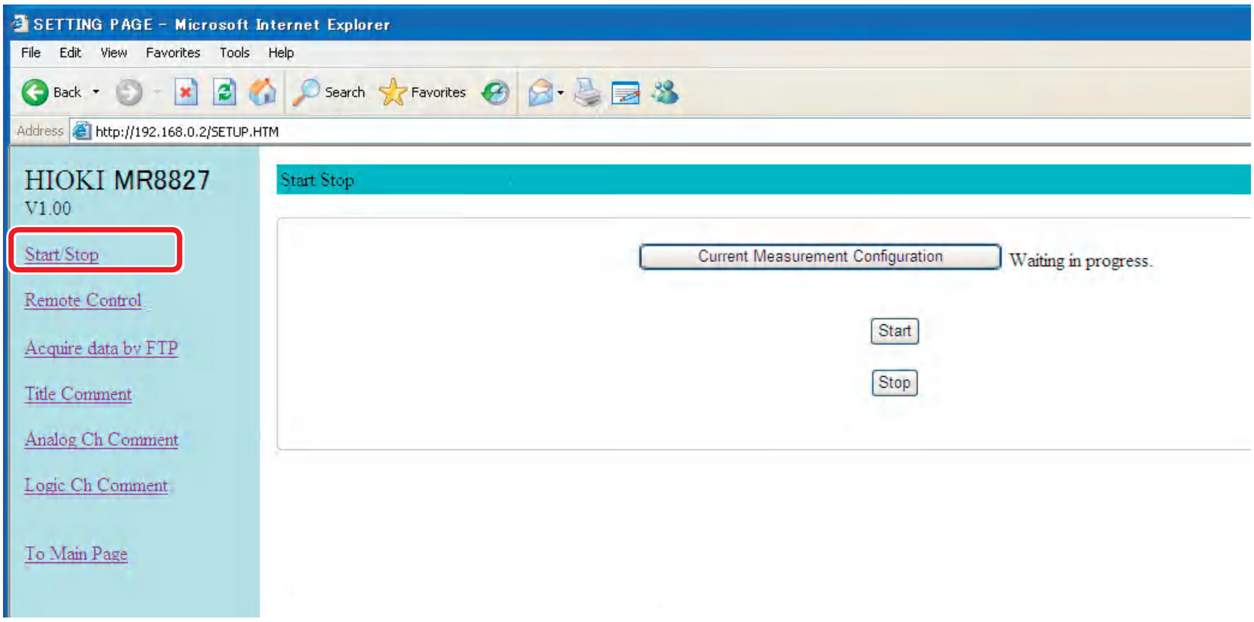
16.2.3 Operate the Instrument With an Internet Browser

Start/Stop Measurement

You can start and stop measurement.

Measurement Start/Stop Screen

To open the screen, click **[Start/Stop]** in the list of operations.



Procedure

Click **[Start]** to start the measurement.
Click **[Stop]** to stop the measurement.

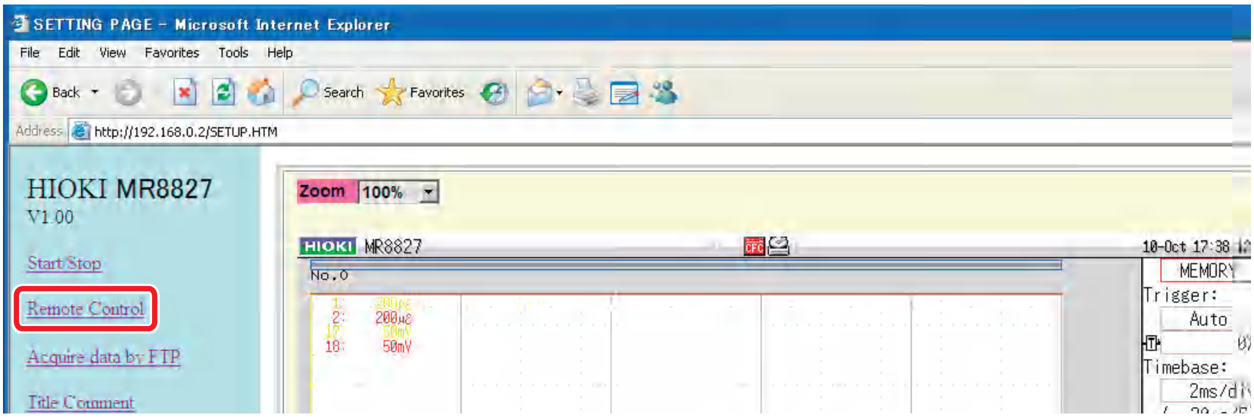
Click **[Current Measurement Configuration]** to display up information about the current measurement configuration.

Remote Operation

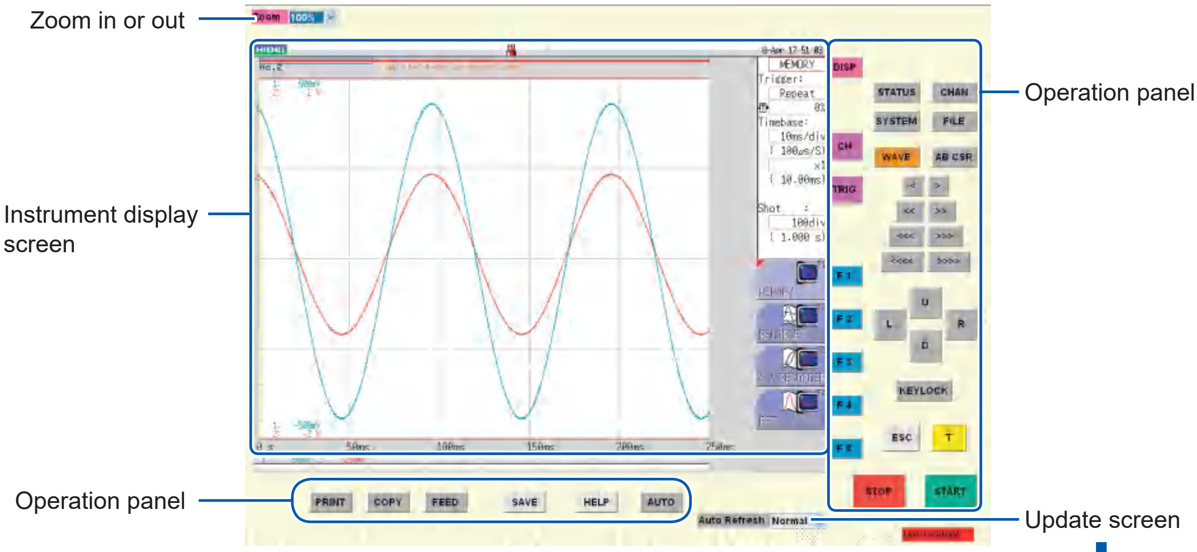
The instrument can be controlled from a remote location. (This remote operation is mainly intended for monitoring the screen. If you want more nimble remote operation, use Model 9333 LAN Communicator.)

Remote Control Screen

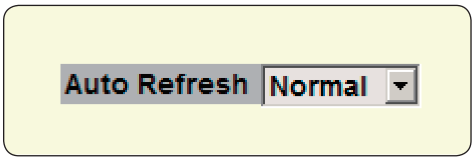
Click **[Remote Control]** in the list of operations to open the screen.



The remote control screen is divided into the instrument display section and operation panel.



When auto-update is enabled, screen information is sent from the instrument to the PC at regular intervals to keep the display updated.



Set display update speed.
Available settings:
Normal/Slow/Very Slow

Basic Operations

When you click a button on the operation panel, the instrument performs the same action is if the corresponding key on the unit was pressed. However, simultaneously activating more than one button is not possible. You can directly click inside the screen to move the flashing cursor onto the item or click a GUI figure directly to set it.
The keys and controls on the instrument are active also during remote operation.

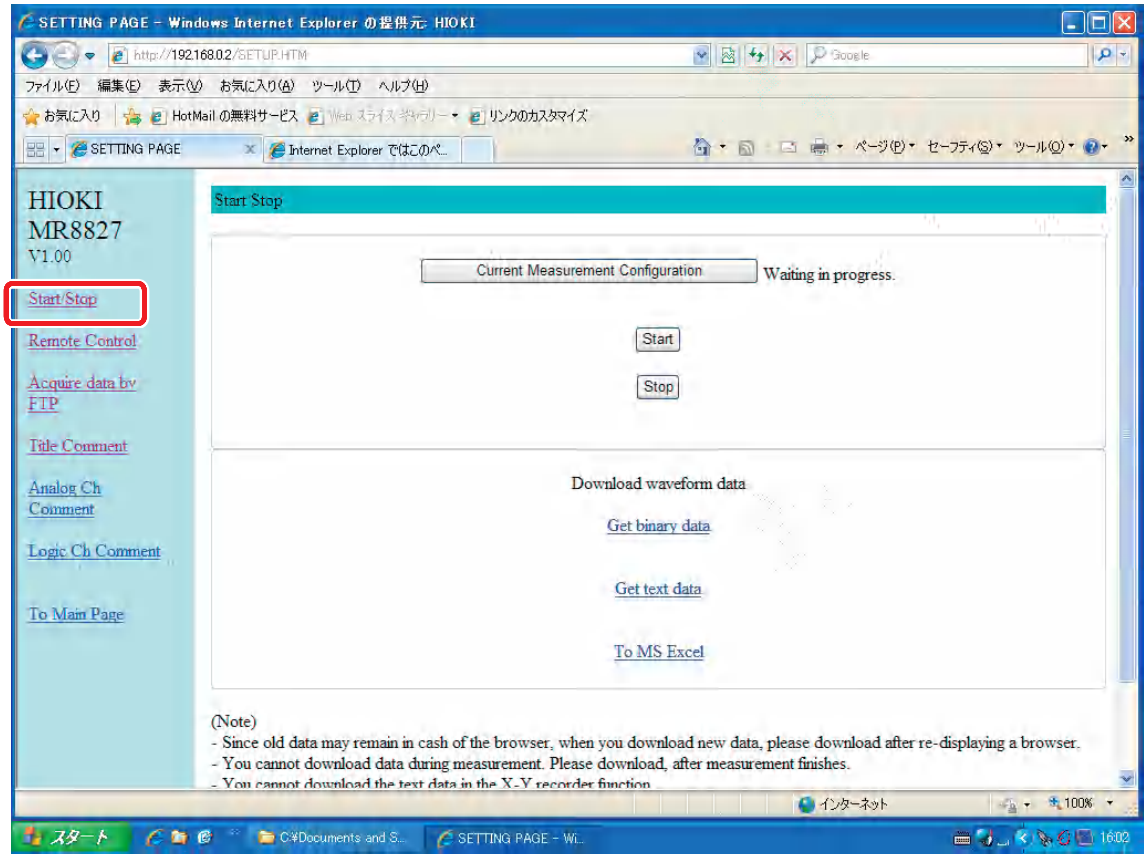
- Remote control may not be possible when JRE has not been installed. (p. 323)
- Printing may be interrupted if it occurs during remote operation. Set display update speed to **[Slow]** or **[Very Slow]**.

Download Memory Data From the unit

You can download measured data.
The data format can be binary, text, or Excel*.
* Microsoft Excel®

Measured Data Download Screen

Click **[Start/Stop]** in the list of operations to open the screen.



(Note)
- Since old data may remain in cash of the browser, when you download new data, please download after re-displaying a browser.
- You cannot download data during measurement. Please download, after measurement finishes.
- You cannot download the text data in the X-Y recorder function.

Procedure

1 **Start measurement.**

2 **Stop measurement.**

3 **Select one of the options below the measured data display.**

Get binary data	Retrieve binary data.
Get text data	Retrieve text data.
To MS Excel	Display data in Excel. cursors. (Data can be opened with Microsoft Excel)

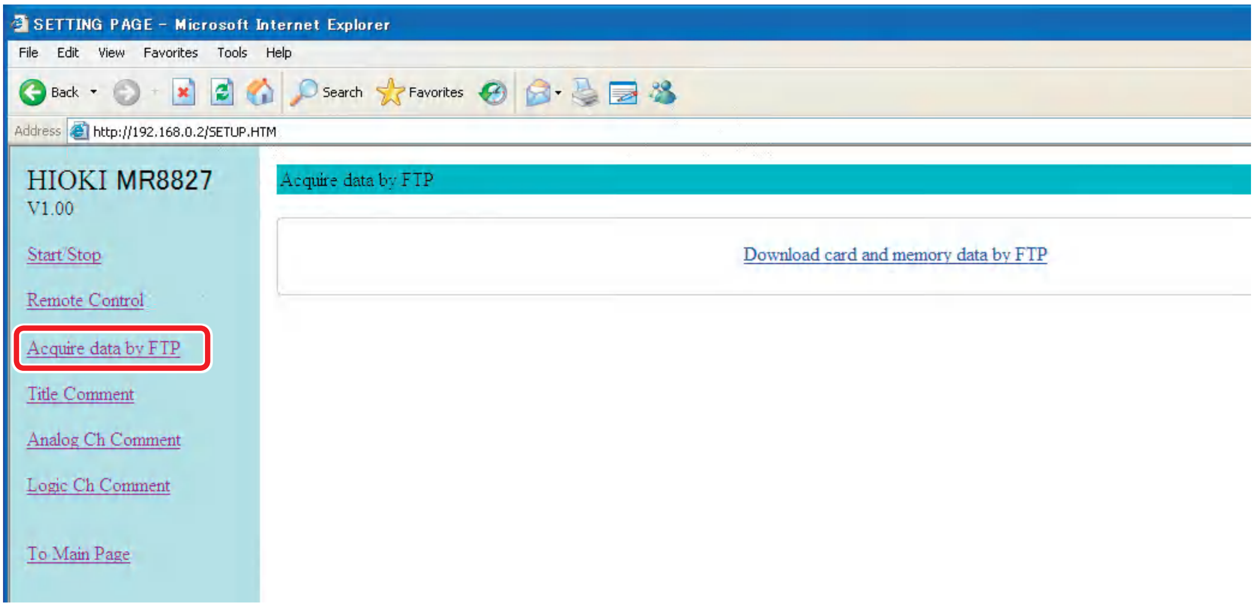
- It may not be possible to retrieve data when JRE has not been installed on your PC. (p. 323)
- You cannot download measured data during measurement. Stop measurement and then download data.
- When you use Internet Explorer and press **[To MS EXCEL]** and select **[Open]**, an error may occur during transmission. In such a case, select **[Save]**.

Download Data by FTP

You can use FTP to download data from the CF card, built-in drive, or a USB memory stick.

Data Download Screen for FTP

Click **[Acquire data by FTP]** in the list of operations to open the screen.



Procedure

Click [Acquire data by FTP].
A list of folders is displayed.

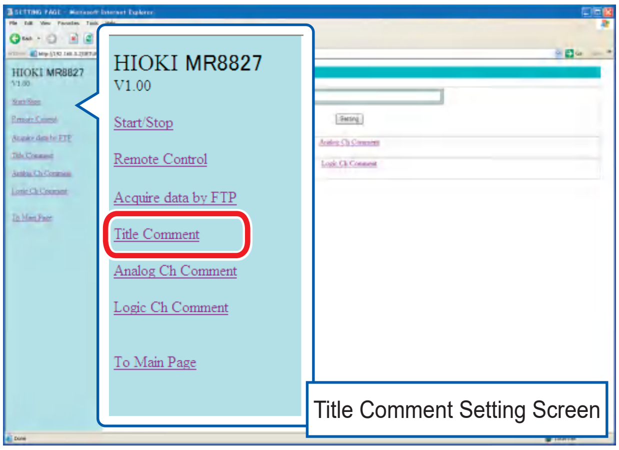
For information on how to perform file operations, refer to “16.3.3 Use FTP for File Operations” (p. 333).

Entering a Comment

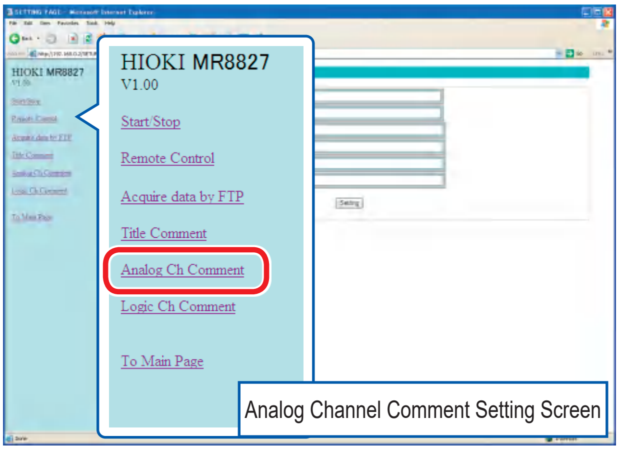
You can specify strings to be used as title comments, logic channel comments, and analog channel comments.
Information about the module type and channel (installation location in the module) can be obtained and used only for the respective channel.

Comment Setting Screen

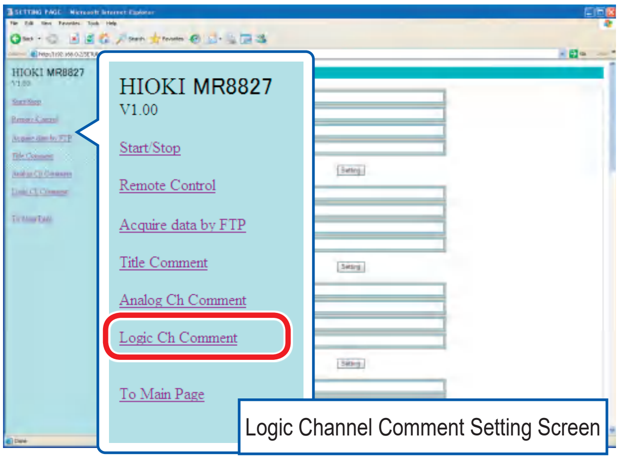
Click **[Title Comment]**, **[Analog Ch Comment]**, or **[Logic Ch Comment]** in the list of operations to open the screen.



Title Comment Setting Screen



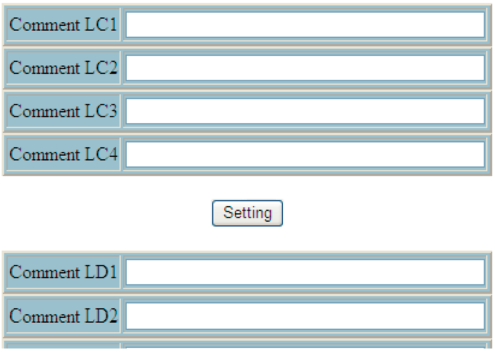
Analog Channel Comment Setting Screen



Logic Channel Comment Setting Screen

Procedure

Enter a string in the comment input field and click [Setting].
The comment string can be up to 40 characters long.



16.3 Access Files on the Instrument From a PC (Using FTP)

By using a PC FTP client, you can transfer files from the instrument's storage media to the PC and perform other file operations.

- This instrument is equipped with an FTP (File-Transfer-Protocol, RFC959 compliant) server.
- You can use Internet Explorer® or other popular FTP clients.

- The FTP server of the instrument allows only one connection at a time. More than one PC cannot access the server simultaneously.
- If no command is sent from a PC for more than one minute after connecting to the FTP server, the FTP may disconnect the PC. If this occurs, reconnect via your FTP client.
- FTP operation will be interrupted when measurement is started.
- Before inserting or removing a CF card or USB memory stick, terminate the FTP connection.
- Do not perform file operations while FTP is being used.
- With Internet Explorer®, the refresh date of files may not match those of the main unit.
- With Internet Explorer®, temporary internet files may retain data from a previous access, so previous data may be obtained instead of the newest data.

To use FTP, the instrument must be properly set up and connected via LAN cable to the PC.
Refer to “16.1.1 LAN Settings on the Instrument” (p. 318) or “16.1.2 Connect the Instrument to a PC With a LAN Cable” (p. 321).

Be careful when moving files by FTP, as some FTP client/browser programs may delete all selected files or folders from the source if you cancel a transfer before completion. Rather than moving files in one step, we recommend copying (downloading) and then manually deleting from the source.

Things to Check Before Using FTP

Relationship Between Storage Media and Directories

Each of the various types of storage media appears as a directory on the FTP server.

/CF.................. CF card
/HDD................ Built-in drive
/RAM................ Internal memory
/USB1 .... USB memory stick
/STORAGE ....Storage memory

Limitations

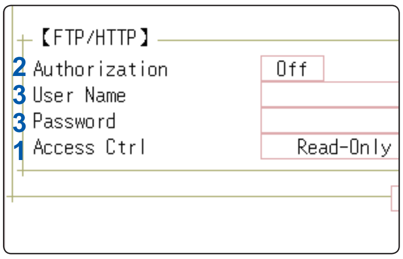
During measurement you cannot access files.

Even when the built-in drive is SSD, it is recognized as HDD.

16.3.1 FTP Settings at the Instrument

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.



【FTP/HTTP】
Authorization Off
User Name
Password
Access Ctrl Read-Only

1 **Set the access restrictions.**

Move the cursor to **[Access Ctrl].**

Read/ Write	File deletion and renaming are permitted.
Read-Only	Only file reading is permitted. This prevents files from being deleted or changed from outside the instrument.

2 **Choose authorization settings.**

Move the cursor to **[Authorization].**

Off	Web server authentication not used. (Default setting)
On	Web server authentication used.

3 **When [On] is selected**

Set up a user name and password.

Move the cursor to **[User Name]** and **[Password]** and enter suitable information.

Refer to “8.1.3 Alphanumeric Input” (p. 149) or “Authorization User Name and Password” (p. 319).

The user name and password for authentication are the same for the Internet browser and for FTP.

4 **Apply the settings.**

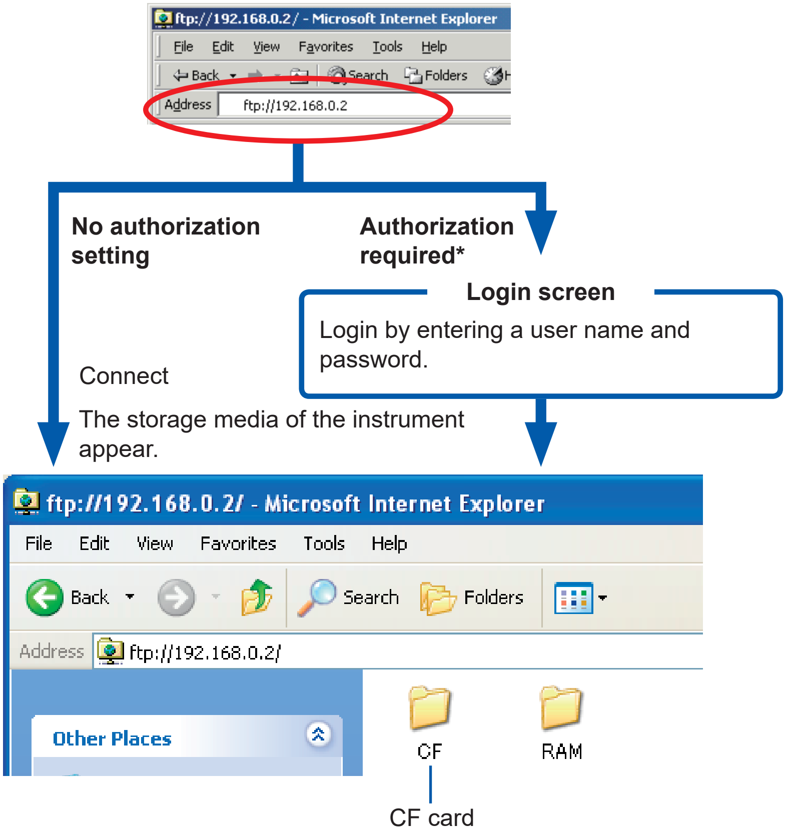
Move the cursor to **[Reset].**
Select **[Reflect Set].**

The “LAN was reconnected” message will appear at the bottom of the screen.

16.3.2 Use FTP to Connect to the Instrument

The following example shows how to use the Internet Explorer® browser on Windows 7.
Launch Internet Explorer® on the PC and enter “ftp://” followed by the IP address of the instrument in the address bar.

If the IP address of the instrument is “192.168.0.2”


ftp://192.168.0.2/ - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Folders
Address ftp://192.168.0.2
No authorization setting
Authorization required*
Login screen
Connect
ftp://192.168.0.2/ - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Folders
Address ftp://192.168.0.2/
Other Places
CF
RAM
CF card

Login by entering a user name and password.

The storage media of the instrument appear.

Click to display files stored on the media.

* An authorization user name and password have been set in the System screen - **[Interface]** sheet.
Refer to “16.3.1 FTP Settings at the Instrument” (p. 331).

You can also enter the user name and password, delimited by “:” and “@,” in front of the normal IP address.

[ftp://Username:Password@instrument IP address]

Example: When the user name is “hioki” and the password is “1234”, enter [ftp://hioki:1234@192.168.0.2].

If the connection fails

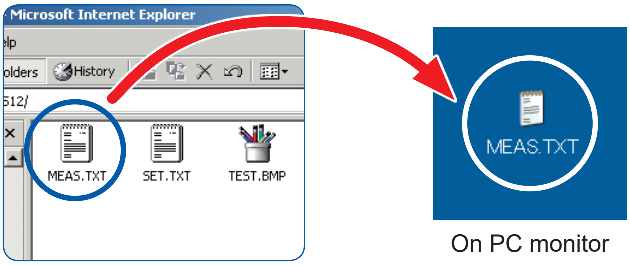
Check the communication settings of the instrument.
Refer to “LAN Setup Workflow” (p. 320).

16.3.3 Use FTP for File Operations

To Download Files

Select the file to download from the folder list and drag and drop* it on the download destination (the desktop or a folder outside the Internet Explorer® window).
* Click the file and hold the button down. Move the mouse pointer to the target destination, and then release the button

Drag and Drop

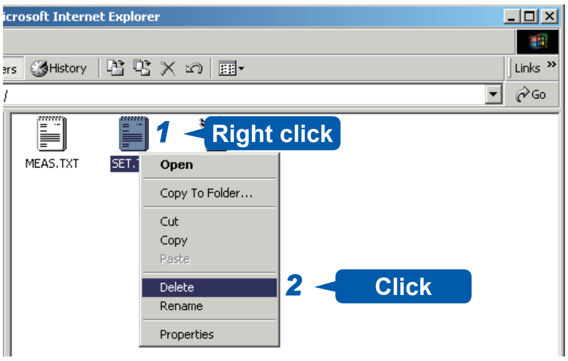


On PC monitor

Minutes and seconds may not be reflected on the time stamp (date) of the file.

To Delete or Rename Files

Right click a file in the FTP folder list, and select **[Delete]** or **[Rename]** from the pull-down menu.



Files cannot be uploaded to the instrument from the PC. To copy a file to the built-in drive of the instrument, use a USB memory stick or CF card.

16.4 Transferring Data to the PC

The supplied USB cable can be used to transfer data from the built-in drive or CF card to a PC.
For information on how to use the supplied application software for data analysis, refer to the application's Help function.
To Install and startthe application software, refer to “16.5 Wave Viewer (Wv)” (page 335).

System requirements

The computer running Windows 7, Windows 8, or Windows 10

⚠CAUTION

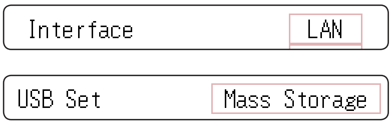
To avoid equipment failure, do not disconnect the USB cable while communication is in progress.

Use a common ground for the instrument and PC. Use of different ground circuits will result in a potential difference between the instrument’s ground and the PC’s ground. If the USB cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.

Instrument Settings

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.

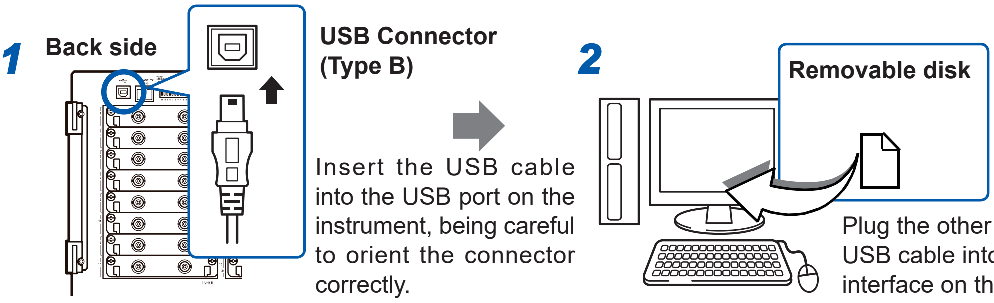

Interface LAN
USB Set Mass Storage

1. **Move the cursor to [Interface], and select [LAN].**
2. **Move the cursor to [USB Set], and select [Mass storage HDD] and [Mass storage CF].**

Operations to the USB memory stick, built-in drive or CF card from the unit are restricted during **[Mass Storage].** Furthermore, the printer prints at **[Slow/Fine]**, regardless of the **[Print Speed]** setting.

To Connect the USB Cable

Preparations
Stop measurement and make sure that the File screen is not displayed.



Insert the USB cable into the USB port on the instrument, being careful to orient the connector correctly.

Plug the other end of the USB cable into a USB interface on the PC.

When the connection is established, the PC will recognize the instrument as a removable disk.
The PC can now access data on the built-in drive or CF card of the instrument.

Disconnecting the USB Cable

To disconnect the USB cable of the instrument from a PC that is currently running, use the **[Safely Remove Hardware]** icon and follow the prescribed steps.

16.5 Wave Viewer (Wv)

The viewer has a CSV conversion function. Converted files may be read by a spreadsheet program. This section explains how to install, uninstall, start and quit Wave Viewer.

System requirements
The computer running Windows 7, Windows 8, or Windows 10

Installation (Windows 7)

1. **Insert the supplied application disc (CD) into the CD-ROM drive.**

   The top page appears automatically.
   If it does not appear, open the “index.htm” file with your Web browser.

2. **Selects the display language.**

   Click the **English** icon.

3. **Click the [Wave viewer (Wv)] icon.**

   The Wv specifications and revision history are displayed.

4. **Click the [Install] icon at the top right of the page.**

   The **[File Download]** dialog appears.

5. **Click [Open].**

   A confirmation dialog appears. Proceed with installation.

6. **Click [Next].**

   A window for selecting the installation destination opens.
   Click the **[Browse]** to change the installation folder.

7. **Click [Next].**

   The installation starts.

Startup

Before using the program, review the “READ ME” text file.

From the Windows® Start menu, select [Programs] - [HIOKI] - [Wv.]

This will start the Wave Viewer application.

Shutdown

Access the menu of the Wave Viewer application and select [File] - [Exit] to shut down the program.

Alternatively, you can click the Close button at the top right of the screen.

Uninstallation

1. **Click the Windows® Start button, click [Control Panel], and then click [Uninstall a program].**

2. **Select [HIOKI Wave Viewer (Wv)] and uninstall the application.**

   When upgrading to a newer version of Wave Viewer, uninstall the old version before installing the new version.

16.6 USB Connection and Settings (Before Command Communication)

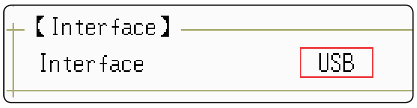
Use the USB cable supplied with the instrument to connect the instrument to the PC. The instrument can then be controlled from the PC.
Before command communication is possible, USB settings must be configured and the connection established.

16.6.1 USB Settings on the Instrument

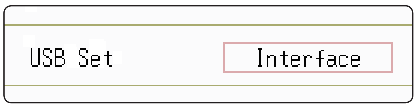
Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.

Move the cursor to [Interface], and select [USB].
The **[USB Set]** item is automatically set to **[Interface].**



【Interface】
Interface USB



USB Set Interface

When the interface has been set to **[USB]**, the following functions are not available.
- Using a USB memory stick
- Viewing data of the unit on a PC

16.6.2 Install the USB Driver

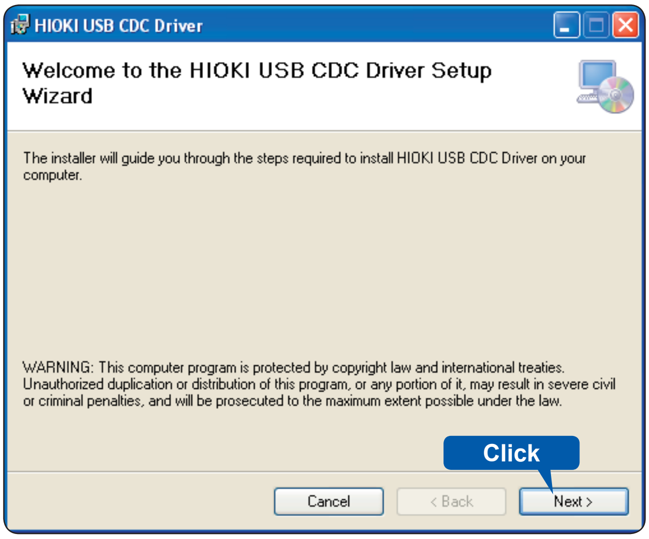
Before connecting the instrument by USB, perform the following procedure to install the USB driver.

Perform the installation with administrator privileges.

1 **Run [HiokiUsbCdcDriver.msi] in the CD X:\Driver folder.**
(**[X]** indicates the CD-ROM drive. The letter will differ depending on your PC.)

Depending on the environment, the dialog box may take some time to appear.

2 Click **[Next]**.



HIOKI USB CDC Driver

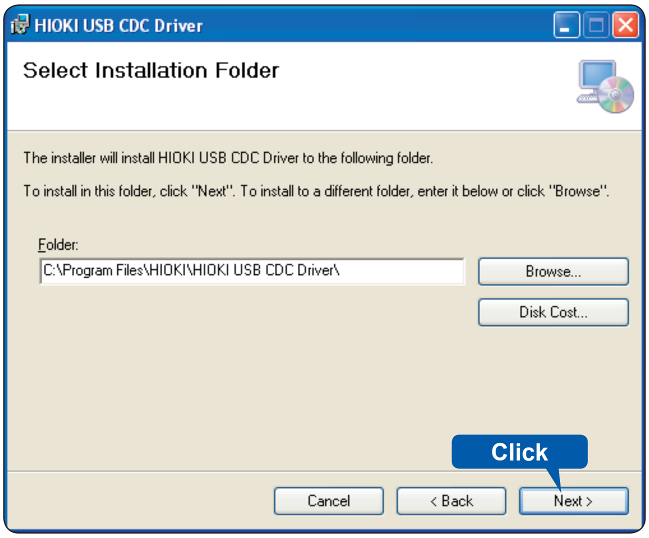
Welcome to the HIOKI USB CDC Driver Setup Wizard

The installer will guide you through the steps required to install HIOKI USB CDC Driver on your computer.

WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.

3 Click **[Next]**.

To change the installation destination
Click **[Browse...]** to change the folder to install into.
Normally, there is no need to change.



HIOKI USB CDC Driver

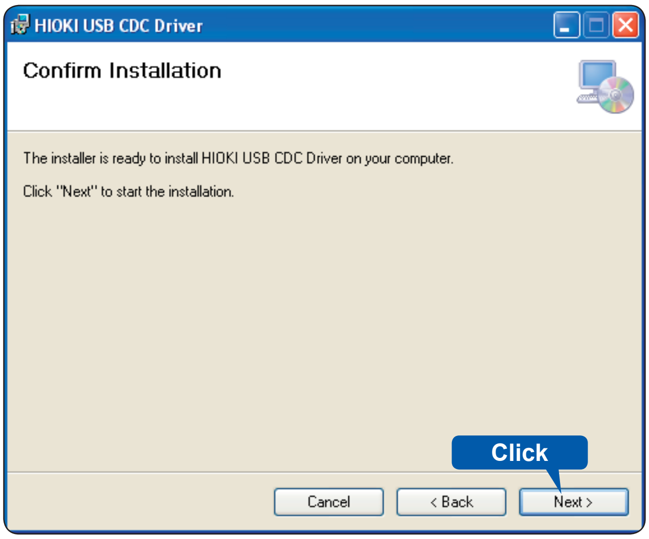
Select Installation Folder

The installer will install HIOKI USB CDC Driver to the following folder.

To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".

Folder: C:\Program Files\HIOKI\HIOKI USB CDC Driver\

4 Click **[Next]**.



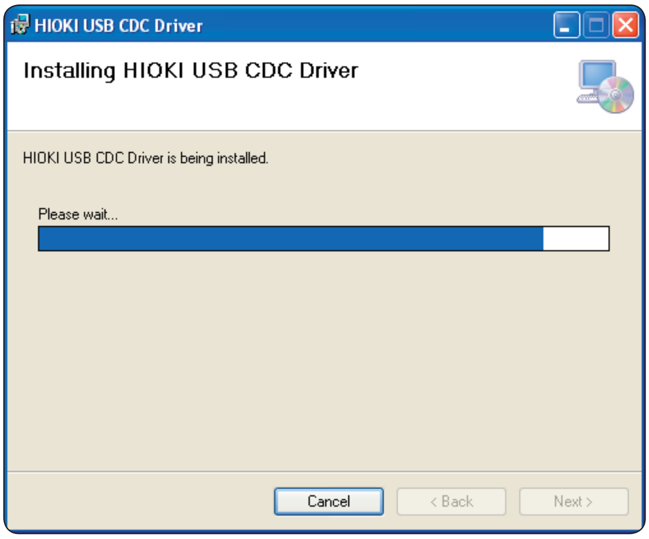
HIOKI USB CDC Driver

Confirm Installation

The installer is ready to install HIOKI USB CDC Driver on your computer.

Click "Next" to start the installation.

The installation starts.



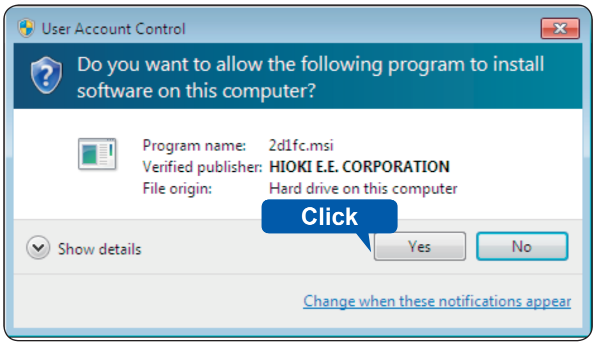
HIOKI USB CDC Driver

Installing HIOKI USB CDC Driver

HIOKI USB CDC Driver is being installed.

Please wait...

When a dialog box requesting your permission to continue the program appears, click **[Yes]**.

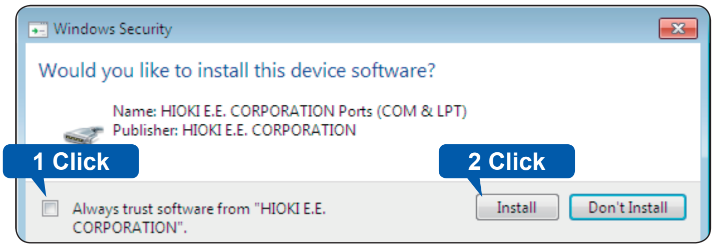


User Account Control

Do you want to allow the following program to install software on this computer?

Program name: 2d1fc.msi
Verified publisher: HIOKI E.E. CORPORATION
File origin: Hard drive on this computer

Sometimes another dialog box requesting your permission to install the software may appear. When it does, select **[Always trust software from “HIOKI E.E. CORPORATION.”]** checkbox and click **[Install]** to continue.

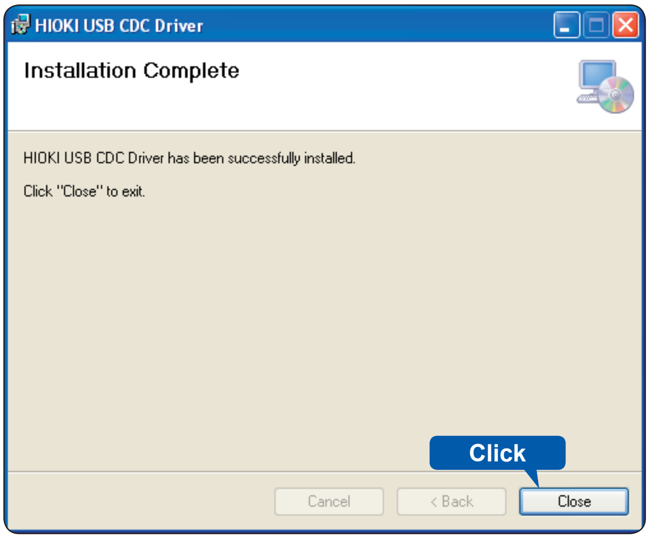


Windows Security

Would you like to install this device software?

Name: HIOKI E.E. CORPORATION Ports (COM & LPT)
Publisher: HIOKI E.E. CORPORATION

5 **When installation is complete and the dialog box appears, click [Close] to exit.**



HIOKI USB CDC Driver

Installation Complete

HIOKI USB CDC Driver has been successfully installed.

Click "Close" to exit.

This completes the driver installation.

To Connect the Instrument and PC on Which the Driver is Installed

System requirements

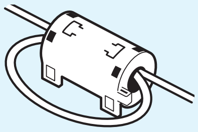
The computer running Windows 7, Windows 8, or Windows 10

⚠CAUTION

🚫 To avoid equipment failure, do not disconnect the USB cable while communication is in progress.

❗ Use a common ground for the instrument and PC. Use of different ground circuits will result in a potential difference between the instrument's ground and the PC's ground. If the USB cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.

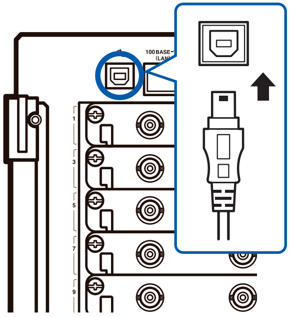
- If you connect the USB cable while both the instrument and the PC are off, be sure to turn on the PC first. If you turn them on in the wrong order, communication between the instrument and PC will not be possible.
- If there is a possibility of interference from other equipment in the vicinity, wind the USB cable once around the supplied ferrite clamp-on choke (for LAN/USB cable), as shown in the illustration at right.

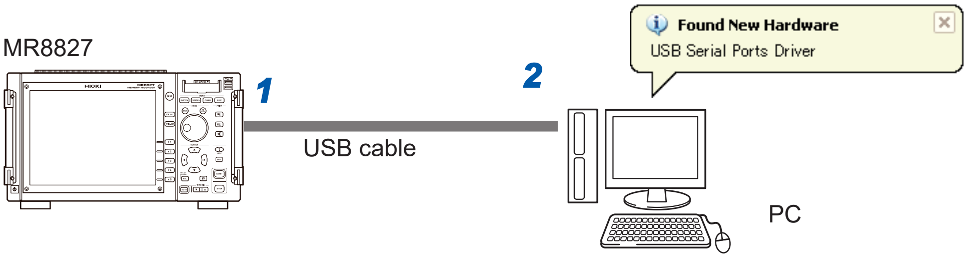


1 **Plug the USB cable supplied with the instrument into the USB connector (Type B) on the back side of the instrument.**

2 **Connect the other end of the cable to a USB port on the PC.**

Back side





Found New Hardware
USB Serial Ports Driver

The instrument will be recognized and preparation to use the device will complete automatically.

To Uninstall the USB Driver

When the USB driver is no longer needed, uninstall it by following the procedure below (for the computer running Windows 7).

1 **Click the Windows® Start button, click [Control Panel], and then click [Uninstall a program].**
The list of the installed programs appears.

2 **Click [HIOKI USB CDC Driver], and then, click [Uninstall].**

16.7 Controlling the Instrument with Command Communications (LAN/USB)

You can control the instrument remotely via the communications interface (LAN or USB).

- For details, see the Communication Command Instruction Manual on the supplied application disc.
- Before using command communications, the LAN settings or USB settings and connection must have been configured properly.

Refer to LAN “16.1” (p. 318) and USB “16.6” (p. 336).

⚠CAUTION

In an environment where noise from inverters or similar devices is present, errors may occur when controlling the instrument remotely. Take care to ensure that the environment is not subject to excessive noise.

Setting Details

Delimiter	The Delimiter item specifies LF or CR+LF as the newline delimiter in command response messages. The instrument understands both settings: LF or CR+LF.
Header	Use for control of communications commands. The Header item specifies whether to prefix headers to command response messages. For more information about commands, refer to the Communications operation manual on the supplied CD.
Command Port (Port number) (LAN only)	The instrument uses the TCP/IP protocol for communications. TCP/IP allows communicating devices to establish multiple connections, which are distinguished by port number. By default the instrument uses port numbers 8800 to 8809. • 8800 to 8801 reserved • 8802 (instrument is server): For communications command control • 8803 to 8809 reserved Normally these ports do not need to be changed. You can change them if certain ports cannot be used for security reasons, or if certain ports are not available on the communicating PC. Set only the most significant three digits. The least significant digit (0 to 9) is used by the instrument, or reserved for use by the instrument.

16.7.1 Settings on the Instrument

Set items related to command communications.

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[Interface]** sheet.

1 **Set the delimiter.**

Move the cursor to **[Delimiter].**

LF	Send character code 0x0a.
CR+LF	Send character codes 0x0d and 0x0a.

2 **Select header settings.**

Move the cursor to **[Header].**

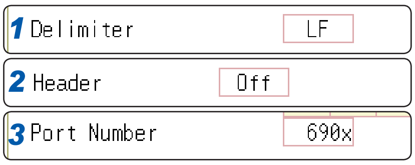
Off	Do not add a header to response data.
On	Add a header to response data.

3 **Set the communications command port. (LAN only)**

Move the cursor to **[Port Number]**
and enter the port number.

About headers
The response to a **[:FUNCTION?]** query command from the PC differs according to the header setting.
[On] .... **[:FUNCTION MEM]**
[Off] .... **[MEM]**

About port numbers
Specify only the most significant 3 digits of the 4-digit port number.
If you specify “880x,” port number 8802 will be used. (p. 340)



1 Delimiter LF
2 Header Off
3 Port Number 690x

16.8 Operate the Instrument Remotely and Acquire Data Using the Model 9333 LAN Communicator

The Model 9333 LAN Communicator, which is the optional communication program for PCs, allows the PC to control the instrument remotely and to store data directly. Additionally, Model 9333 enables waveforms to be printed from a printer connected to the PC.

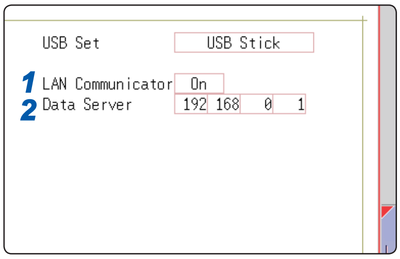
Procedure

1 **Set the LAN Communicator.**

On	Use the LAN Communicator.
Off	Do not use the LAN Communicator.

2 **Set the data collection server**

Specify the IP address of the PC on which Model 9333 LAN Communicator is running to communicate with the instrument. The IP address is required to acquire data using the Model 9333 LAN Communicator.
If necessary, set “**LAN:**” as the save destination on the **[File Save]** sheet, and set **[LAN]** as the output destination of the Print Key operation and the auto-print setting.



USB Set USB Stick
1 LAN Communicator On
2 Data Server 192 168 0 1

3 **Apply the settings.**

Move the cursor to **[Reset].**
Select **[Reflect Set].**

The “LAN was reconnected” message will appear at the bottom of the screen.

For the settings of the Model 9333 LAN Communicator, see the instruction manual of Model 9333 LAN Communicator.

17 External Control

This chapter describes how to operate the instrument using the external control terminals.
We use the term external control terminals to refer to all of the terminals.

⚠DANGER

To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximums to the external control terminals.

	I/O terminals	Maximum input voltage
Instrument	START/EXT.IN1	-0.5 V DC to 7 V DC
	STOP/EXT.IN2	-0.5 V DC to 7 V DC
	PRINT/EXT.IN3	-0.5 V DC to 7 V DC
	GO/EXT.OUT1	DC 50 V 50 mA 200 mW
	NG/EXT.OUT2	DC 50 V 50 mA 200 mW
	EXT.SMPL	-0.5 V DC to 7 V DC
	TRIG OUT	DC 50 V 50 mA 200 mW
	EXT.TRIG	-0.5 V DC to 7 V DC
U8793 Arbitrary Waveform Generator Unit	IN	-0.5 V DC to 7 V DC
	OUT	DC 30 V 50 mA

⚠WARNING

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to external control terminals or external connectors.

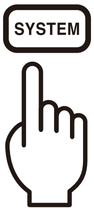
- **Always turn off the power to the instrument and to any devices to be connected before making connections.**
- **Be careful to avoid exceeding the ratings of external control terminals and external connectors.**
- **Ensure that devices and systems to be connected to the external control terminals are properly isolated.**

⚠CAUTION

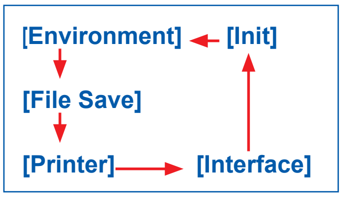
- Use a common ground for both the instrument and the connection equipment. Use of different ground circuits will result in a potential difference between the instrument's ground and the connected equipment's ground. If the communications cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.
- While connecting or disconnecting the communication cables, ensure that the power supply of the instrument and the device to be connected is cut off. This may cause damage or malfunctioning.
- After connecting the communications cable, tighten the screws on the connector securely. Failure to secure the connector could result in equipment malfunction or damage.

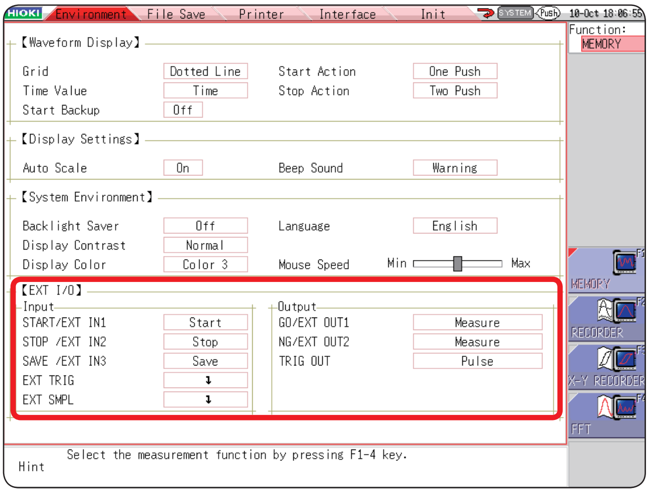
Signals input to the external control terminals take effect even when the operating keys are locked.

To Open the [Environment] Sheet



Press this key repeatedly to display the various sheets.


[Environment] ← [Init]
↓
[File Save]
↓
[Printer] → [Interface] ↑



Function: MEMORY

【Waveform Display】

Grid: Dotted Line
Time Value: Time
Start Backup: Off
Start Action: One Push
Stop Action: Two Push

【Display Settings】

Auto Scale: On
Beep Sound: Warning

【System Environment】

Backlight Saver: Off
Display Contrast: Normal
Display Color: Color 3
Language: English
Mouse Speed: Min – Max

【EXT I/O】

Input
START/EXT IN1: Start
STOP /EXT IN2: Stop
SAVE /EXT IN3: Save
EXT TRIG: ↓
EXT SMPL: ↓

Output
GO/EXT OUT1: Measure
NG/EXT OUT2: Measure
TRIG OUT: Pulse

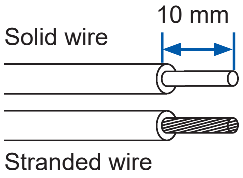
Hint: Select the measurement function by pressing F1-4 key.

17.1 Connect to External Control Terminals

The method for connecting to the external control terminals is as follows.

Procedure

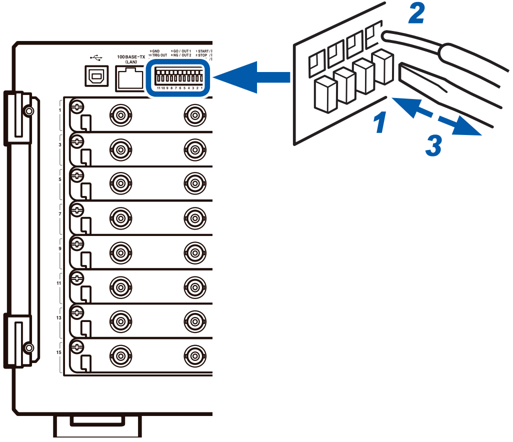
Cables to connect



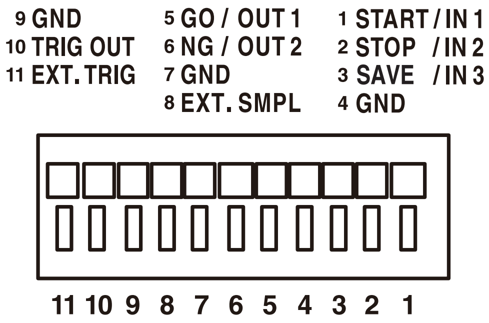
Recommended wire	Solid wire: 0.65 mm dia. (AWG22) Stranded wire: 0.32 mm^2 (AWG22)
Compatible wire:	Solid wire: 0.32 to 0.65 mm dia. (AWG28 to 22) Stranded wire: 0.08 to 0.32 mm^2 (AWG28 to 22) Strand diameter: 0.12 mm or more (per wire)
Stripped length:	9 to 10 mm
Button pressing tool:	Flat-blade screwdriver (shaft diameter: 3 mm, tip width: 2.6 mm)

Connection procedure

Back side



1. **Push in the button on the connector with a flat-blade screwdriver or other tool.**
2. **With the button held in, insert the cable into the cable connection hole.**
3. **Release the button.**
   The cable is locked.



Terminal No.	Operation
1	Input external signal and execute the following • Start/end measurement • Print/save data • Pen Up/Down Operation (for X-Y recorder operation)
2	
3	
4	GND (common with the instrument's ground)
5	Output instrument status as a signal
6	
7	GND (common with the instrument's ground)
8	Input external signal and set sampling rate
9	GND (common with the instrument's ground)
10	Output signal when triggering occurs
11	Input external signal as trigger source

17.2 External I/O

17.2.1 External Input (START/IN1) (STOP/IN2) (SAVE/IN3)

External control signals can be applied to start and stop measurement and to print and save data. The factory-default settings are **[Start]**, **[Stop]**, and **[Save]**.

Signal Input Procedure

1. **Connect the cables for the corresponding external input signals to the START/IN1, STOP/IN2, SAVE/.IN3, and GND terminals.**

   Refer to "17.1 Connect to External Control Terminals" (p. 345).

2. **Press the SYSTEM key to open the [Environment] sheet, and move the cursor to [START/EXT. IN1], [STOP/EXT. IN2], or [SAVE/EXT. IN3].**

3. **Select the operation to be performed by the instrument in response to external signal input.**

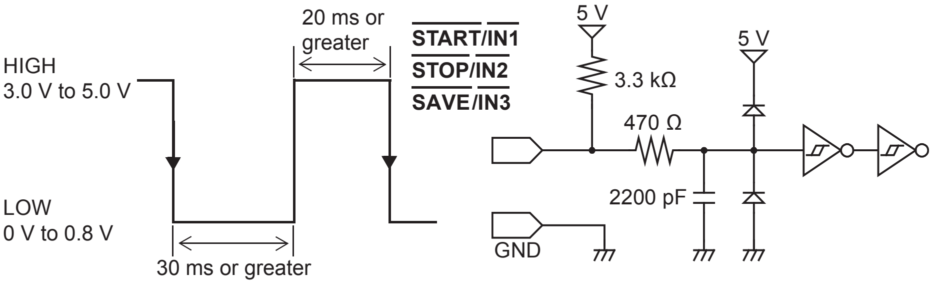
Start	Start measurement. (not affected by **[START Action]** (p. 315))
Stop	Stop measurement. (Operations after measurement, such as numerical calculations and automatic saving will be carried out)
Start/Stop	Start measurement on LOW level, and stop measurement on HIGH level.
Abort	Stop measurement immediately. (Operations after measurement, such as numerical calculations and automatic saving will not be carried out)
Print	Same operation as **PRINT** key (cannot be used with Selective Printing (p. 118))
Save	Save to the media specified for the **SAVE** key, according to the specified conditions. (cannot be used with Selective Printing (p. 94))
Pen Up/Down	A LOW level signals "pen-down" operation and a HIGH level signals "pen-up" operation (for X-Y recording).
RUN/STOP	Runs/stops waveform output. (RUN at LOW level, STOP at HIGH level).
PAUSE	Stops waveform output temporarily.

- For STOP operation, follows the configured **[STOP Action]** (p. 315).
- External input is not available when the HELP screen or a dialog window is displayed.

4 **Short circuit the terminal and GND, or input a HIGH level (3.0 V to 5.0 V) or LOW level (0 V to 0.8 V) pulse wave or rectangular wave to the terminal.**

Control with the LOW level of the input waveform.

Voltage range	High level: 3.0 V to 5.0 V, LOW level: 0 V to 0.8 V
Pulse width	High level: 20 ms or greater, LOW level: 30 ms or greater
Maximum input voltage	−0.5 V to 7 V



17.2.2 External Output (GO/OUT1) (NG/OUT2)

Signals can be output that indicate the instrument's judgment state.

Signal Output Procedure

1 **Connect the GO/OUT1, NG/OUT2, and GND terminals to the device(s) to be controlled by single wires.**

Refer to “17.1 Connect to External Control Terminals” (p. 345).

2 **Press the SYSTEM key to open the [Environment] sheet, and move the cursor to [GO/EXT. OUT1] or [NG/EXT. OUT2].**

3 **Select the conditions under which the instrument outputs a signal.**

(When the **[GO/EXT. OUT1]** item is selected)

Measure	A LOW signal is output when the judgment result is GO (pass).
Waveform Evaluation	A LOW signal is output when the waveform evaluation result is GO (pass).
Value Evaluation or Waveform Evaluation	A LOW signal is output when either the value calculation or waveform calculation evaluation result is GO (pass).
Value Evaluation and Waveform Evaluation	A LOW signal is output when both the value calculation and waveform evaluation result are GO (pass).
Error	Output a LOW level signal when an error occurs.
Busy	A LOW signal is output when external start operation is disabled, such as during startup, saving, and printing.
Trigger	Output a LOW level signal while instrument is waiting for a trigger.

GO evaluation result output (low level output) is held until the next measurement starts.

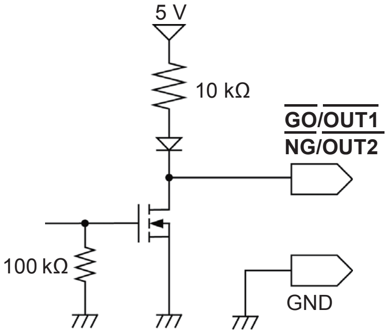
(When the **[NG/EXT. OUT2]** item is selected)

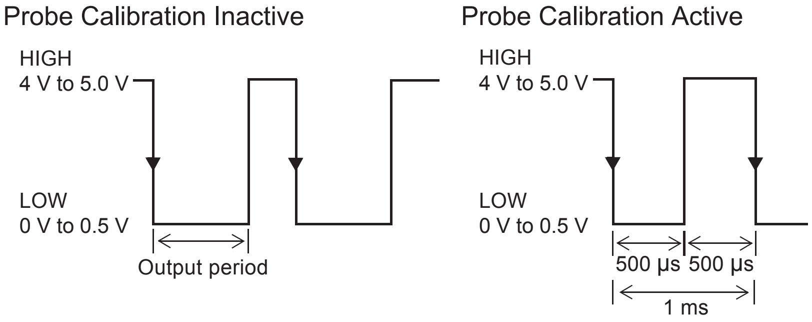
Measure	A LOW signal is output when the judgment result is NG (fail).
Waveform Evaluation	A LOW signal is output when the waveform evaluation result is NG (fail).
Value Evaluation or Waveform Evaluation	A LOW signal is output when either the value calculation or waveform calculation evaluation result is NG (fail).
Value Evaluation and Waveform Evaluation	A LOW signal is output when both the value calculation and waveform evaluation result are NG (fail).
Error	Output a LOW level signal when an error occurs.
Busy	A LOW signal is output during measurement, saving, and printing, and a HIGH signal is output when finished.
Trigger	Output a LOW level signal while instrument is waiting for a trigger.
Probe Calibration	1 kHz output for calibrating Model 9665 10:1 Probe and the 9666 100:1 Probe.

NG evaluation result output (low level output) is held until the next measurement starts.

The signal for the specified state is output.

Output signal	Open drain output (with voltage output) active LOW
Output voltage range	High level: 4.0 V to 5.0 V LOW level: 0 V to 0.5 V (current: 15 mA)
Maximum input voltage	50 V DC, 50 mA, 200 mW


5 V
10 kΩ
GO/OUT1
NG/OUT2
100 kΩ
GND


Probe Calibration Inactive
HIGH
4 V to 5.0 V
LOW
0 V to 0.5 V
Output period
Probe Calibration Active
HIGH
4 V to 5.0 V
LOW
0 V to 0.5 V
500 μs
500 μs
1 ms

17.2.3 External Sampling (EXT.SMPL) MEM

This applies to the Memory function only.
The sampling rate can be controlled by applying an external signal.

Signal Input Procedure

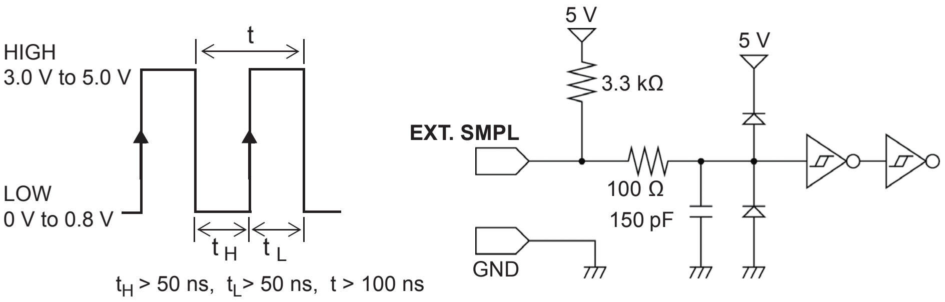
1. **Connect the cables for the corresponding output signals to the EXT.SMPL and GND terminals.**
2. **Press the SYSTEM key to open the [Environment] sheet, and move the cursor to [EXT. SMPL].**
3. **Select whether the sampling event occurs on the rising edge (↑)or falling edge (↓) of the waveform.**
4. **Input HIGH level (3.0 V to 5.0 V) and LOW level (0 V to 0.8 V) pulse waves or rectangular waves to the EXT.SMPL terminal.**

   Data is sampled on the rising edge or falling edge of the input waveform. Note that the sampling frequency is limited by the selected edge.
   For proper operation, pulse width must be at least that shown in the following table.

Minimum external sampling pulse width

Setting (EXT.SMPL)	Pulse width					
	When Roll Mode is **[On]**			When Roll Mode is **[Off]**		
	t_H	t_L	t	t_H	t_L	t
↑	> 5 µs	> 5 µs	> 10 µs	> 50 ns	> 50 ns	> 100 ns
↓	> 5 µs	> 5 µs	> 10 µs	> 50 ns	> 50 ns	> 100 ns

Voltage range	High level: 3.0 V to 5.0 V, LOW level: 0 V to 0.8 V
Pulse width	HIGH, LOW level: 50 ns or greater
Response frequency	10 MHz or lower
Maximum input voltage	−0.5 V to 7 V



- When a sampling signal of 5 MHz or greater is input, trigger points are delayed by 1 sample.
- When set to **[Auto]** or **[On]**, Roll Mode can be used with external sampling. However, it is set to **[Off]** if the external sampling input is faster than 100 kHz to avoid degraded sampling accuracy.
- The anti-aliasing filter (A.A.F) is disabled regardless of its setting.
  See “8.10.1 Settings for the Anti-Aliasing Filter (A.A.F)” (page 172)
- When Roll Mode is set to **[Auto]** or **[On]**, externally sampled signals will not be accepted for the following periods:
  (1) 150 µs to 200 µs after the first sampling clock has been entered
  (2) 2 clock periods after dead time of (1)
- When external sampling is valid, the output settings of Models MR8790, MR8791, and U8793 can not be updated.

17.2.4 Trigger Output (TRIG OUT)

You can output a signal when a trigger event occurs. This feature allows multiple instruments to be controlled for parallel synchronous operation.

Signal Output Procedure

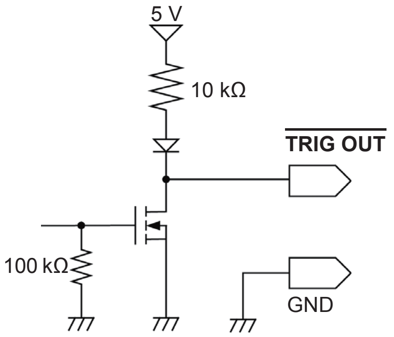
1. **Connect the cables for the output signals to the TRIG OUT and GND terminals.**
   Refer to “17.1 Connect to External Control Terminals” (p. 345).
2. **Press the SYSTEM key to open the [Environment] sheet, and move the cursor to [TRIG OUT].**
3. **Select the output signal type for the trigger output terminal.**

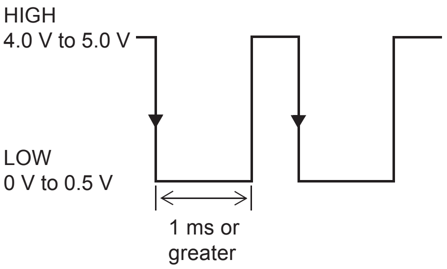
Pulse	After LOW level output, the signal goes HIGH after a specified interval.
Level	After the trigger occurs, a LOW level signal will be output during waveform retrieval.

When a trigger event occurs, a pulse wave changing from HIGH (4.0 V to 5.0 V) to LOW (0 V to 0.5 V) will be output from the TRIG OUT terminal.

Output signal	Open drain output (with voltage output) active LOW*
Output voltage range	HIGH level: 4.0 V to 5.0 V LOW level: 0 V to 0.5 V (current: 15 mA)
Pulse width	Pulse width at pulse setting time: 2 ms ± 1 ms Pulse width at level setting time: (sampling rate × no. of data points after trigger) or more
Maximum input voltage	50 V DC 50 mA 200 mW

* Triggering should occur when the signal voltage level changes from HIGH to LOW.





- Trigger events occur and signals are output when the auto-ranging function is used with the Memory Function. Keep this in mind when performing auto-range measurement while using the trigger output terminal.
- When using memory division, the trigger output (TRIG_OUT terminal output) may output the Low level or output erratically under the following conditions.
  - The timebase is 5 μs/div to 100 μs/div
  - The record (measurement) time is 5 ms or less
  - Tracking wave display is **[Off]**.

17.2.5 External Trigger Terminal (EXT.TRIG)

You can input external signals as trigger sources. This feature allows multiple instruments to be controlled for parallel synchronous operation.

Signal Input Procedure

1. **Connect the cables for the corresponding external input signals to the $\overline{\text{EXT.TRIG}}$ and GND terminals.**

   Refer to “17.1 Connect to External Control Terminals” (p. 345).

2. **In the Trigger Settings window, set External trigger to [On].**

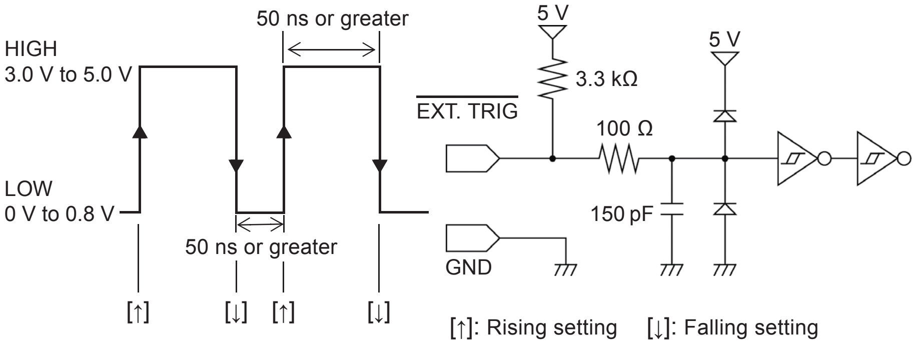
3. **Press the SYSTEM key to open the [Environment] sheet, and move the cursor to [EXT. TRIG].**

4. **Select whether the trigger event occurs on the rising edge (↑)or falling edge (↓) of the waveform.**

5. **Short-circuit the $\overline{\text{EXT.TRIG}}$ terminal and GND, or input a HIGH level (3.0 V to 5.0 V) or LOW level (0 to 0.8 V) pulse wave or rectangular wave to the EXT.TRIG terminal.**

   A trigger event occurs on the rising or falling edge of the input waveform.

Voltage range	High level: 3.0 V to 5.0 V, LOW level: 0 V to 0.8 V
Pulse width	HIGH level: 50 ns or greater, LOW level: 50 ns or greater
Maximum input voltage	−0.5 V to 7 V



18 Specifications

18.1 General Specifications of the Unit

Basic Specifications

Measurement functions	• Memory function • Recorder function • X-Y recorder function • FFT function
Maximum number of channels	Analog 32 channels + Logic 32 channels, Analog 28 channels + Logic 64 channels (Together with the logic channels the instrument provides, when 2 modules of Model 8973 Logic Unit are installed)
Number of modules	Up to 16 modules Restrictions • Up to 4 modules of Model 8971 Current Unit can be installed. • Up to 2 modules of Model 8973 Logic Unit can be installed in every slot except those for Unit 9 through Unit 16.
Number of the instrument logic channels	32 (The input connectors of logic channels share the ground with the instrument.) • Installing Model MR8990 Digital Voltmeter Unit in every slot for Unit 1, Unit 2, Unit 9, and Unit 10 disables the instrument logic channels. • Restrictions imposed when the instrument logic channels are used (when the logic measurement is set to on) Measurement resolution of each measuring module decreases to 12 bits when the module is installed in any of the slots for Unit 1, Unit 2, Unit 9, and Unit 10. No frequency measuring module is available when the module is installed in any of the slots for Unit 1, Unit 2, Unit 9, and Unit 10.
Memory capacity	Total memory 512 MW 16 MW/ch (in 32 ch mode), 32 MW/ch (in 16 ch mode), 64 MW/ch (in 8 ch mode), 128 MW/ch (in 4 ch mode)
Maximum sampling rate	20 MS/s (All channels simultaneously)
Time axis accuracy	± 0.01% (shows the relative error between the grid and time)
External control terminals	External trigger input, trigger output, external sampling input, GND External output 2 terminals (GO, NG), External input 3 terminals (START/IN1, STOP/IN2, SAVE/IN3)
Clock functions	Auto-calendar, auto-leap year judgment, 24-hour timer Accuracy: ±100 ppm (within the operating temperature range) Reference value: ± 10 ppm (25°C)
Backup battery life	Approx. 10 years for clock and settings (Reference value: 25°C)
Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity	0°C to 40°C (32°F to 104°F), 20% RH to 80% RH (no condensation)
Storage temperature and humidity	−10°C to 50°C (14°F to 122°F), 90% RH or less (no condensation)
Temperature and humidity for guaranteed accuracy	23°C ± 5°C (73°F ± 9°F), 20% RH to 80% RH (no condensation)
Guaranteed accuracy period	1 year
Product warranty period	3 years (1 year for Model U8330 SSD Unit)

Withstand voltage	Between chassis and power line: 1.69 kV AC for 1 min at least 50 MΩ at 500 V DC Between module and chassis: 3 kV AC for 1 min at least 100 MΩ at 500 V DC
Power source	Rated power supply voltage: 100 V to 240 V AC (continuous input) (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) Rated power supply frequency: 50Hz/60Hz Anticipated transient overvoltage: 2500 V
Maximum rated power	350 VA max. (When using the printer) 220 VA max. (When not using the printer)
Dimensions	Approx. 401W × 233H × 388D mm (15.79"W × 9.17"H × 15.28"D) (including protrusions except for the handle) Approx. 400W × 220H × 388D mm (15.75"W × 8.66"H × 15.28"D) (excluding protrusions)
Mass	Approx. 12.6 kg (444.4 oz.) (Model MR8827 only) Approx. 16.6 kg (585.5 oz.) (When Model 8966 Analog Unit is installed)
Standards	Safety EN61010 EMC EN61326 Class A

Printer Recording Section (For Model 8827 With Optional Model U8350 Printer Unit, Which Shall be Specified at the Time of Placement of Order, Installed)

Recording system	Thermosensitive recording system using thermal line head
Recording paper	Approx. 216 mm × 30 m (8.50" × 98.43 ft.) roll-type thermosensitive paper (Model 9231 Recording Paper)
Recording width	Overall recording width: Approx. 208 mm (8.19") Waveform portion: Approx. 200 mm (7.87")
Recording speed	Approx. 50 mm/s (Maximum)
Paper feeding accuracy	± 1% (25°C, 60% RH)
Recording paper loading	One-touch system

Display

Display type	10.4-in SVGA TFT color LCD (800 × 600 dots)
Display resolution	T-Y waveform display: 25 div (horizontal axis [time axis]) × 20 div (vertical axis [voltage axis]) X-Y waveform display: 20 div (X axis) × 20 div (Y axis)
Dot pitch	0.264 (Vertical) × 0.264 (Horizontal) mm
Backlight	On/Off
Backlight operating life	Approx. 80,000 hours (LED light source half-life of brightness)

External Interfaces

LAN

Number of ports	1
Compliant standards	IEEE802.3 Ethernet 100BASE-TX FTP server, HTTP server
Connector	RJ-45
Maximum cable length	100 m

USB

Compliant standards	USB2.0 compliant
Host	Number of ports: 2 Connector: Series-A receptacle Connecting device: USB memory stick, Mouse
Function	Connector: Series-B receptacle Connecting device: Computer Functions: mass storage device (for file transfer from built-in drive or CF card to computer) Communications support (PC-controlled)

External Storage

CF Card

CF card slot	50-pin, 1 slot
Card types	CompactFlash
Compatible CF card	Model 9728 PC Card: 512 MB Model 9729 PC Card: 1 GB Model 9830 PC Card: 2 GB
Data format	FAT, FAT32
Storage contents	Setting configurations, Measurement data (binary or text, part between the A and B cursors can be saved), Screen images (BMP), Printing images (BMP), Numerical calculation results, Thinned storage (simple text), Waveform evaluation conditions (evaluation area + setting conditions), Arbitrary waveform data (when Model U8793 is installed), Generation program data (when Model U8793 is installed), Pulse pattern data (when Model MR8791 is installed)

Built-in drive (Model U8330 SSD Unit with an option which must be specified when ordering, installed)

Storage system	2.5-inch SSD (MLC)
Storage capacity	128 GB
Data format	FAT32
Storage contents	Setting configurations, Measurement data (binary or text, part between the A and B cursors can be saved), Screen images (BMP), Printing images (BMP), Numerical calculation results, Thinned storage (simple text), Waveform evaluation conditions (evaluation area + setting conditions), Arbitrary waveform data (when Model U8793 is installed), Generation program data (when Model U8793 is installed), Pulse pattern data (when Model MR8791 is installed)

Accessories, Options

Accessories	Refer to “Unit and Accessories” (p. 3).
Options	Refer to “Appendix 3.1 Options” (p. A9).

18.2 Common Functions

Modules, Waveform Display

Measurement mode	Depends on module used
Measurement range	Depends on module used
Input coupling	Depends on module used
Low-pass filter	Depends on module used
Displayed graphs	Displayed graph setting with multi-screen and multi-printing function enabled (up to 16 graphs)
Waveform display	Off or selectable from among 16 colors
Printer density	4 levels
Waveform display position	In increments of 1% Preset (ascending, descending, 0%, 50%)
Zero adjust	All channels and ranges together
Waveform display magnification	Horizontal axis (Time axis): ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, ×1/500, ×1/1000, ×1/2000, ×1/5000, ×1/10000, ×1/20000 (expansion only with Memory function) Vertical axis (Voltage axis): ×100, ×50, ×20, ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10
Variable display function	Specified by upper and lower limit values, by displayed amplitude per division
Scaling	Automatic scaling (10:1, 100:1, 1000:1, Various probes selectable) Manual scaling (conversion ratio setting, two-point setting and unit settings)
Invert function	Polarity reversal
Vernier function	Included
Commenting	Alphanumeric and Japanese characters (title for each analog and logic channel)
Comment entry method	Simple input by using the keys of the Memory HiCorder, mouse, and keyboard Stored string and historical string entry (pre-stored and previously used strings can be recalled, inserted and edited)
Copy channel settings	Copy and paste, or paste all
Logic setting	Width: Selectable from three types: wide, standard, and narrow Display position: Freely settable in increments of 1% Display bits: Off or selectable from among 16 colors, settable individually for each bit
Zoom function	The waveform screen is divided vertically in two, and the lower portion displays zoomed waveforms.

Trigger Function

Trigger method	Digital comparison
Trigger modes	• Memory function, FFT function: Single, Repeat, Automatic • Recorder function: Single, Repeat
Trigger source	Analog Unit (CH1 to CH32), Standard Logic 32 Channels Independent trigger criteria settable for each channel Free-run operation occurs when all trigger types are off. External Trigger occurs by applying a 2.5 V falling edge signal, shorted terminals Manual trigger, Timer trigger
Trigger criteria	AND or OR of each trigger source

Trigger types (analog)	• Level trigger Triggering occurs at the signal rising (or falling) through a specified voltage level. • Voltage Sag Trigger (Drop) Triggering occurs when peak voltage falls below the specified level. (for 50 Hz/60 Hz commercial power) • Window trigger Upper and lower trigger threshold levels are specified Triggering occurs when the signal enters or exits the defined threshold range. • Period trigger A trigger period reference voltage level and period range are specified The period of the signal rising (or falling) through the specified level is measured, and triggering occurs when the period is outside of the specified range. • Glitch trigger Set voltage level and pulse width (glitch width) Triggering occurs when the signal pulse width is narrower than the specified pulse width beginning at the moment when rising or falling across a specified voltage level. • Event trigger Set the event count for the level trigger or glitch trigger. The number of signal rising (or falling) through the specified voltage level is counted, and triggering occurs when the specified event count is exceeded.
Trigger types (logic)	Pattern (mask) trigger by 1, 0, × (×: do not care)
Trigger types (external trigger)	External signal is used as trigger.
Trigger types (timer trigger)	Triggering occurs at a preset time.
Trigger filter	• Memory function, FFT function: Off, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 2.5, 5.0, 10.0 div • Recorder function: Off/On (10 ms fixed)
Trigger level resolution	0.1%f.s. (f.s. = 20 div)
Pre-trigger	Applicable to memory function or FFT function % setting: 0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, −95% div setting: 1 div increments
Trigger priority	Off/On
Trigger marker	Trigger marks indicate positions of trigger events
Trigger timing	Start (Memory function, FFT function), Stop (Recorder function), Start & Stop (Recorder function)
Trigger search function	After measurement, searches for positions that meet trigger criteria
Trigger output	Open-collector output With 5 V voltage output, active low, low output level: 0 V to 0.5 V (current value of 15 mA) Pulse width at level setting time: (sampling rate × number of data points after trigger) or more Pulse width at pulse setting time: 2 ms ± 1 ms
Trigger input and output terminals	Terminal block
Level display function	Included

18.3 Measurement Functions

18.3.1 Memory Function

Timebase	5, 10, 20, 50, 100, 200, 500 μs/div 1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div 1, 2, 5, 10, 30, 50, 100 s/div 1, 2, 5 min/div External sampling (100 S/div, arbitrary settings)
Time axis resolution	100 points/div
Sampling period	1/100 of timebase
Recording length	• Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000 div (in 4, 8, 16, 32 channel mode), 200000 div (in 4, 8, 16 channel mode), 500000 div (in 4, 8 channel mode), 1000000 div (in 4 channel mode) • Arbitrary recording length: Can be set in units of divisions (up to 1,280,000 div)
Screen and printing settings	1, 2, 4, 8, 16, X-Y1 or X-Y4 screens
Interpolation function	Line, line and dot (with X-Y)
Waveform scrolling	Left-right scrolling by jog and shuttle knobs, Backward scrolling is available during Roll Mode display
Overlay function	Auto: Always overlays when starting, and clears by restarting Manual: Overlays waveforms only when necessary, and clears as needed
Auto-print*	Automatically prints recording waveforms after the measurement (At slow sampling rate, printing is available while recording.)
Manual print*	By pressing the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Selection printing*	Included, Prints the waveform between A and B cursors (Print All and Print Selection)
Auto-save	Automatically saves data on the CF card, built-in drive, USB memory stick after measuring (binary or text) At slow sampling rate, saving starts during recording.
Report printing*	Included
Channel modes	Select from 32, 16, 8, 4 ch modes

* When Model U8350 Printer Unit is installed

18.3.2 Recorder Function

Timebase	10, 20, 50, 100, 200, 500 ms/div 1, 2, 5, 10, 30, 50, 100 s/div 1, 2, 5, 10, 30 min/div, 1 h/div
Time axis resolution	100 points/div
Sampling period	1, 10, 100 µs 1, 10, 100 ms (select from periods that are 1/100 or less of the timebase)
Recording length	• Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000 div • Arbitrary recording length: Can be set in units of divisions (up to 80,000 div) • Continuous
Screen and printing settings	1, 2, 4, 8, 16 screens
Waveform storage	The most recent 80,000 divisions of measurement data is retained in internal memory
Waveform scrolling	Left-right scrolling by jog and shuttle knobs. Backward scrolling during measurement is possible
Real-time printing*	Available with timebase set to 500 ms/div or longer (Start and stop printing by Function key while recording) With 10 ms/div to 200 ms/div recording, prints simultaneously with some delay from recording (Continuous recording length not available) During continuous recording at 10 ms/div to 200 ms/div, print manually after measurement stops
Manual print*	By pressing the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Selection printing*	Included, Prints the waveform between A and B cursors (Print All and Print Selection)
Report printing*	Included
Auto-save	Automatically saves data on the CF card, built-in drive, USB memory stick after measuring (binary or text) When sampling is slow, saving starts during recording.

* When Model U8350 Printer Unit is installed

18.3.3 X-Y Recorder Function

Sampling cycle	1, 10, 100 ms
Recording length	Continuous
Screen and printing settings	1 screen, 4 screens
Number of X-Y display	Up to 8 phenomena
X-Y setting	Select 8 channels out of 32 for X axis and Y axis
Interpolation function	Dot/Line (smooth trace)
Waveform clear	On/Off
Waveform storage	The last 16,000,000 samples of measurement data is retained in internal memory
Pen up/down	Included (all phenomena simultaneously)
External pen control	Controllable by external control terminals (all phenomena simultaneously Up/Down)
Auto-print	None
Manual print*	By pressing the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Auto-save	None

* When Model U8350 Printer Unit is installed

18.3.4 FFT Function

Frequency range	133 mHz to 8 MHz, external
Dynamic range	72 dB (theoretical value), 96 dB (theoretical value) when Model 8968 High Resolution Unit is used
Number of sampling points	1000 points, 2000 points, 5000 points, 10000 points
Frequency resolution	1/400, 1/800, 1/2000, 1/4000
Anti-aliasing filters	Coupled with the frequency range, the cutoff frequency is automatically set. (Only when using the Model 8968 High Resolution Unit or Model U8979 Charge Unit)
Analysis channel setting	Can be selected from desired channels
FFT analysis modes	Storage waveform, linear spectrum*, RMS spectrum*, power spectrum*, cross power spectrum, auto-correlation function, histogram, transfer function, cross-correlation function, impulse response, coherence function, 1/1 octave analysis, 1/3 octave analysis, LPC analysis, phase spectrum * The total harmonic distortion (THD) is displayed when the cursor display is ON.
Display formats	Single, Dual, Nyquist display, Running spectrum display
Window	Rectangular window, Hanning, Exponential, Hamming, Blackman, Blackman Harris, Flat top
Display scale	Linear, Log
Print function	Based on the memory function. Note: Sectional printing is not possible.
Peak hold	Included
Averaging	Simple average of time-domain waveform and spectrum, indexed average, peak hold (frequency axis) Number of times (2, 4, 8, ... to 10,000)

18.4 Other Functions

Calculation-Related Functions

Calculation support function	Memory function
Number of calculations	Up to a maximum of 16 calculations for desired channels
Calculation range	All range, between A and B cursors, after trigger
Calculation types	Average, RMS value, P-P value, maximum value, time to maximum value, minimum value, time to minimum value, period, frequency, rise time, fall time, standard deviation, squared value, X-Y squared value, time to level, level at time, pulse width, duty ratio, pulse count, four basic arithmetic operations, time difference, phase differnce, High level, Low level
Printing of calculation results	Included
Automatic saving of calculation results	After measuring, automatically saves to CF card, USB memory stick, built-in drive (text format)
Judgment of calculation results	Calculation results can be judged based on the specified maximum/minimum value Stop condition: GO, NG, GO&NG
Evaluation output	GO, NG signal output from external control terminal Open-collector output With 5-V voltage output, active low, low output level: 0 V to 0.5 V (current value of 15 mA) Pulse width: at least 1.8 ms

* When Model U8350 Printer Unit is installed

Waveform Calculation Functions

Calculation support function	Memory function
Number of calculations	Up to a maximum of 16 calculations for desired channels
Calculation range	All range, between AB cursor selections
Calculation recording length	Up to 1/4 of maximum memory length
Operators	Four arithmetic operations, absolute values, indexes, common logarithms, square root, moving average, differential (primary, secondary), integral (primary, secondary), parallel displacement in time axis direction, trigonometric function, reverse trigonometric function, Integration time correction based on NPLC setting
Printing of calculation results*	Included
Automatic saving of calculation results	After measurement, automatic saving to CF card, USB memory stick, built-in drive (binary, .TXT file)

* When Model U8350 Printer Unit is installed

Memory Division Functions

Memory division support function	Memory function
Number of memory divisions	2 to 1024
Divided recording length	Can be set as desired (but depends on the number of divisions)

Sequential saving	Possible by specifying start and end blocks
Sequential saving dead time	When block display is OFF: 1 to 8 samples (timebase: 5 μs/div to 20 μs/div) 1 sample (timebase: 50 μs/div or more) When block display is ON: 40 ms or more (timebase 5 μs/div to 20 μs/div) 1 sample (timebase: 50 μs/div or more)
Multi-block saving	Saving of waveforms is possible by specifying the desired blocks of divisions
Block display	Display can be set to ON or OFF
Block overlaying	Desired blocks or all blocks

Cursor Measurement Functions

Cursor functions	All functions supported
Number of cursors	Two (Cursors A and B)
Cursor types	Line (vertical or horizontal), trace
Cursor movements	A Cursor, B Cursor, A&B Cursors
Measurement functions	A Cursor: Potential at each cursor, time from trigger event A&B Cursors: Time differences between cursors, potential, frequency (period)
Cursor-supported channels	All channels (default), any specified channel
Included functions	Partial printout*, partial saving

* When Model U8350 Printer Unit is installed

Monitor Functions

Monitor display	Level monitor: Display the level and numerical value by selecting the level monitor with the **DISP** key DMM display: Display the numerical values by pressing the **DISP** key
Numerical value display	Instantaneous value display, with hold function
Level monitor sampling	10 kS/s (fixed)
Refresh rate	0.5 s or more, depends on the NPLC settings when using the Model MR8990 Digital Voltmeter Unit

Position Display (VIEW) Functions

Display function	All types of positions Memory division blocks (When using memory division) Waveform search results Past waveform history (When memory division is OFF, depends on recording length)
Position display	Displays the relative position of the currently displayed waveform within the overall recording length, as well as locations of cursors and trigger events
Block display	Block usage status (When memory division is ON) Past waveform history status (When memory division is OFF) Displayed block position
Jump function	Jump to trigger position/cursor position Jump to desired block (When using memory division) Jump to past waveform (When memory division is OFF) Jump to waveform search position

Waveform Evaluation Function

Waveform evaluation functionality	Compares memory functions (Y-T waveform, X-Y waveform) and FFT function Created waveform area with captured waveforms and determines whether the captured waveform falls inside or outside the corresponding area.
Evaluation modes	Out: NG (fail) if any part of the waveform falls outside the area. All out: NG (fail) if the entire waveform falls outside the area.
Evaluation stop conditions	GO, NG, GO&NG Printer output can be generated or the waveform can be saved when evaluation stops.
Evaluation output	GO/NG output from external control terminal Open collector output With 5-V voltage output, active LOW, LOW output level: 0 V to 0.5 V (Current value of 15 mA) Pulse width: 1.8 ms or more
Waveform evaluation time	Evaluation time: 100 ms or less; evaluation period: 250 ms or less* * 1 channel, timebase of 5 μs/div, recording length of 25 div, magnification factor of 1, 2 input waveform periods When sampling is slow, waveforms can be evaluated during measurement.
Graphic editor	Unit: Includes an editor for creating waveform evaluation reference areas. External: Waveform evaluation reference areas (BMP data) created with third-party software on a PC can be loaded into the instrument.
Editor commands	Load wave, zoom in/out, fill color, draw shape, eraser, clear all, clear select area, invert colors, cancel, exit

Waveform Generation Function

The detailed hardware functions conform to the generator module specifications of Models MR8790, MR8791, and U8793

Waveform generation mode	Depends on generator modules of Models MR8790, MR8791, and U8793
Waveform output control	Output control RUN (generation), STOP (stop), PAUSE (suspension) Output control method Manual: Controls output by using the **F** key on the settings screen. Measurement and synchronization: Outputs in synchronization with measurement start Keys: **START** key, **STOP** key for output control (disable measurement)
Output waveform	Model MR8790 Waveform Generator Unit: DC, Sine waves Model MR8791 Pulse Generator Unit: Pulse, pattern Model U8793 Arbitrary Waveform Generator Unit: DC, sine waves, triangular waves, rectangular waves, pulse, ramp up, ramp down, arbitrary waveform, program
Waveform compatible for output (Only U8793)	Refer to: “Specifications for Arbitrary Waveform Generation Function” (p. 391)

Miscellaneous

On-line help function	Pressing the **HELP** key displays help for the currently selected (blinking) item (The all screen is not used) Basic help (When making settings, displays a brief description of the selected (blinking) item along the bottom of the screen)
Grid types	Display: Off, normal or normal (dark) Printouts: Off, normal, fine, normal (dark), fine (dark)
Comment display	Comments are displayed with channel numbers on the screen and in printouts (channel markers)
Time scale display	Time (seconds, base-60), divisions, date, sample number (screen and printouts)
Variable auto-compensation	Included
Start backup function	Included
Backlight saver	Off, 1 to 30 min
Display color	Color 1 to 3, user-defined
Beep sound	Off, warnings, warnings and operations
Language	English, Japanese, Chinese, Korean
START key function	Press once, twice, hold for two seconds
STOP key function	Press once or twice
External I/O terminals	Trigger control terminals (EXT.TRIG, TRIG OUT), External sampling input terminal (EXT.SMPL) Remote control input terminal (START/IN1, STOP/IN2, SAVE/IN3), Evaluation output terminals (GO/OUT1, NG/OUT2)
Remote control	Select from among terminals for remote input (START/IN1, STOP/IN2, SAVE/ IN3): **[START] [STOP] [START/STOP] [ABORT] [PRINT] [SAVE] [Pen Up/Down] [RUN/STOP] [PAUSE]**
Internal status output	Select from among evaluation output terminals (GO/ OUT1, NG/ OUT2): **[Error], [BUSY], [Trigger]**
Probe calibration output	Select evaluation output terminal (NG/ OUT2): **[Probe Calibration]**
Evaluation output	Select from among evaluation output terminals (GO/OUT1, NG/OUT2): **[Measure]**, **[Waveform Evaluation]**, **[Value Evaluation or Waveform Evaluation]**, **[Value Evaluation and Waveform Evaluation]**
Key-lock function	Press the **ESC** key for 3 seconds. (Key-lock, unlock)
Printout scaling*	Prints waveforms magnified or compressed on the time axis, regardless of Waveform screen display
Print density*	Light, Midlight, Standard, Middark, Dark
Print speed*	Fast (coarse), Normal, Slow (fine)
Print area	Whole waveforms, waveforms between A and B cursors
Upper/lower limit printing*	Off/On
Zero-position comments	Off/On, but not overlaid
Text comment printing*	Load a text file and print comment at printing start time.
Counter printing*	Off, date, counter name and count value
GUI partial printing/ saving	Off/On

List*	Off/On Prints a list of settings
Gauge*	Off/On Prints gauges for measurement channels (If both range and zero position of a channel are set to the same as those of other channels, a single gauge is printed and shared by those channels.) Gauges can be displayed on the screen.
Waveform backup function	None
Auto-setup function	When switched on, settings are automatically loaded from a file on the CF card.
Auto-range function	Execute by pressing the **AUTO** key (Automatically selects the optimal timebase and voltage axis for the input waveform)
Backlight brightness	Selectable from 3 levels
Time setting	Year, Month, Day, Hour, Minutes
Initialization	Clear waveform data System reset (Settings/System settings 1 [Environment] /System settings 2 [Interface])
Self-check function	ROM/RAM, display, printer*, keys, system status
Print key operation	Select whether to print or not (Yes, No) Print destination (printer*, LAN)
Auto-print setting	Auto-print (OFF, ON) Print destination (printer*, LAN)
Channel marker	OFF, CH No., Comments

* When Model U8350 Printer Unit is installed

18.5 File

Data Saving

Supported storage media	CF card, built-in drive*, USB memory stick, internal RAM, LAN (Model 9333 LAN Communicator)
Saved data	Setting data, measurement data, analysis data, screen image, print image waveform evaluation conditions, waveform evaluation areas
Save types	• Setting data (.SET) (Only setting configurations can be saved to internal RAM) • Measurement data Binary format (.MEM, .REC, .FFT, .XYC), Text format (.TXT) • Index Memory division (.SEQ), Division save (.IDX) • Screen image (.BMP) • Print image (.BMP) • Startup (STRATUP.SET) • Waveform evaluation conditions (.ARE) (Saving of evaluation area + setting conditions) • Waveform evaluation area (.BMP) (Saving of evaluation area) • Arbitrary waveform data (.WFG) (when Model U8793 is installed) • Generation program data (.FGP) (when Model U8793 is installed) • Pulse pattern data (.PLS) (when Model MR8791 is installed))
File name entry	Alphanumeric and Japanese characters
Save range	All range, between AB cursors
Data thinning save	When saved in text format Off, 1/2, 1/5, 1/10, 1/20, 1/50, 1/100, 1/200, 1/500, 1/1000
Division save	When saved in binary format 16 MB, 32 MB, 64 MB
Duplicate file name handling	Auto: If a file with the same name exists, saves the file, adding a 4-digit number at the beginning of the file name. Serial: Saves the file, adding a 4-digit number at the beginning of the file name. Overwrite: If a file with the same name exists, overwrites the file. Error: If a file with the same name exists, an error message will be displayed.
Selection of blocks to be saved	Saves the selected blocks when dividing the memory
Selection of channels to be saved	Selects the channels to save (measurement data, calculation data), all channels

Data Loading

Supported storage media	CF card, built-in drive*, USB memory stick, internal RAM
Loadable data types	Setting data, measurement data, analysis data, text comments, waveform evaluation conditions, waveform evaluation area
Loadable data formats	• Setting data (.SET) (Setting configurations can only be loaded to internal RAM) • Measurement data Binary format (.MEM, .REC, .FFT, .XYC), text comments (.TXT) • Index memory division (.SEQ), Division save (.IDX) • Startup (STRATUP.SET) • Waveform evaluation conditions (.ARE) • Waveform evaluation area (.BMP) • Arbitrary waveform data (when Model U8793 is installed), in binary format (.WFG), in text format (.TFG) • Generation program data (.FGP) (when Model U8793 is installed) • Pulse pattern data (.PLS) (when Model MR8791 is installed)
Loading method	New

* When Model U8330 SSD Unit is installed

Other

File management	File information display, copy, renaming File deletion (Single and multiple file selections) Directory management (Create, rename, delete) File sorting (By name, date, size, extension; in ascending or descending order)
One-touch saving	The saving format and data specified in advance can be saved with a single action (One-Touch saving via **SAVE** key or a mouse click).

18.6 Module Specifications

18.6.1 Model 8966 Analog Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Measurement range	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	±0.5% f.s. (Filter 5 Hz On)
Temperature characteristic	±0.06% f.s./°C
Frequency characteristic	DC Coupling: DC to 5 MHz −3 dB AC Coupling: 7 Hz to 5 MHz −3 dB (low cut-off frequency: 7 Hz±50%)
Noise	1.5 mV p-p (typ.), 2 mV p-p (max.) (highest sensitivity range, with input shorted)
Common mode rejection ratio	80 dB or more (at 50 Hz/60 Hz and with signal source resistance 100 Ω or less)
Low-pass filter	OFF, 5±50%, 50±50%, 500±50%, 5 k±50%, 50 k±50%, 500 k±50% (Hz) −3 dB
Input type	Unbalanced input (floating)
Input coupling	AC/ DC/ GND
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
A/D resolution	12 bits
Maximum sampling rate	20 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 V DC
Maximum rated voltage to earth	300 V AC, DC (between individual input channels and enclosure as well as between individual input channels) Measurement category II (anticipated transient overvoltage: 2500 V)
Operating temperature and humidity	As per the Memory HiCorder in which Model 8966 is installed
Operating environment	As per the Memory HiCorder in which Model 8966 is installed
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)
Effect of radiated radio-frequency electromagnetic field	±15% f.s. (max.) at 3 V/m

Effect of conducted radio-frequency electromagnetic field	±45% f.s. (max.) at 3 V (100 mV/div range, with 1 V DC input)
Standards	Safety EN61010 EMC EN61326 Class A
Options	Model L9197 Connection Cord (CAT IV 300 V, CAT III 600 V, 1 A) Model L9198 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9217 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9790 Connection Cord (with Model L9790-01 or 9790-03: CAT III 300 V, CAT II 600 V, 1 A) (with Model 9790-02: CAT III 150 V, CAT II 300 V, 1 A) Model 9322 Differential Probe (with grabber clips attached: CAT II 1000 V) (with alligator clips attached: CAT III 600 V, CAT II 1000 V) Model P9000-01 Differential Probe (CAT III 1000 V) Model P9000-02 Differential Probe (CAT III 1000 V) Model 9665 10:1 Probe (CAT II 300 V) Model 9666 100:1 Probe (CAT II 300 V)

18.6.2 Model 8967 Temp Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Input terminals	Push button-type terminal block (2 terminals/channel)
Measuring object	Thermocouple (K, J, E, T, N, R, S, B, W)

Measurement ranges
Measurable range
Resolution
Measurement accuracy (f.s.=20 div)

Measuring object	Range		Measurable range	Resolution	Measurement accuracy
Thermocouple (not including reference junction compensation accuracy)	K *1	10°C/div	-100°C to 200°C	0.01°C	±0.1% f.s.±1°C (0°C or higher) ±0.1% f.s.±2°C (not lower than -200°C but lower than 0°C)
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1350°C	0.1°C	
	J *1	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1100°C	0.1°C	
	E *1	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 800°C	0.05°C	
		100°C/div	-200°C to 800°C	0.1°C	
	T *1	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 400°C	0.05°C	
		100°C/div	-200°C to 400°C	0.1°C	
	N *1	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1300°C	0.1°C	
	R *1	10°C/div	0°C to 200°C	0.01°C	±0.1% f.s.±3.5°C (not lower than 0°C but lower than 400°C) (For B, accuracy is not guaranteed below 400°C) ±0.1% f.s.±3°C (400°C or higher)
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 1700°C	0.1°C	
	S *1	10°C/div	0°C to 200°C	0.01°C	
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 1700°C	0.1°C	
	B *1	50°C/div	400°C to 1000°C	0.05°C	
		100°C/div	400°C to 1800°C	0.1°C	
	W *2 (WRe5-26)	10°C/div	0°C to 200°C	0.01°C	
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 2000°C	0.1°C	

*1: JIS C 1602-1995, *2: ASTM E-988-96

Reference junction compensation accuracy	±1.5°C (Reference junction compensation: When internal, add to thermocouple measurement accuracy)
Reference junction compensation	Selectable internal or external (during thermocouple measurement)
Temperature characteristic	Add (measurement accuracy × 0.1)/°C to measurement accuracy
Renew Data (Data Refresh)	Selectable from normal, fast, slow

	Fast	Normal	Slow
Data Refresh Rate	Approx. 1.2 ms	Approx. 100 ms	Approx. 500 ms

Wire break detection	Selectable from On or Off
Input resistance	5 MΩ or more (Both when wire break detection is ON and OFF)
Common mode rejection ratio	80 dB or more (at 50 Hz/60 Hz, with signal source 100 Ω or less, Fast data refresh setting) 100 dB or more (at 50 Hz/60 Hz, with signal source 100 Ω or less, Normal data refresh setting)
Input type	Unbalanced input (floating)
Maximum rated voltage to earth	300 V AC, DC (between individual input channels and enclosure as well as between individual input channels) Measurement category II (anticipated transient over-voltage: 2500 V)
Operating temperature and humidity	As per Memory HiCorder in which Model 8967 is installed
Storage temperature and humidity	-20°C to 50°C (-4°F to 122°F), 90% RH or less (no condensation)
Operating environment	As per Memory HiCorder in which Model 8967 is installed
Dimensions	Approx. 106W × 19.8H × 204.5D mm (4.17″W × 0.78″H × 8.05″D)
Mass	Approx. 240 g (8.5 oz.)
Effect of radiated radio-frequency electromagnetic field	±2% f.s. (max.) at 3 V/m
Effect of conducted radio-frequency electromagnetic field	±2% f.s. (max.) at 3 V
Standards	Safety EN61010 EMC EN61326 Class A
Accessories	Ferrite clamp-on choke (2 pieces)
Option	Model 9810 Thermocouples (K)

18.6.3 Model 8968 High Resolution Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Measurement range	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	±0.3% f.s. (Filter 5 Hz On, after zero adjustment)
Temperature characteristic	±0.045% f.s./°C
Frequency characteristic	DC Coupling: DC to 100 kHz −3 dB AC Coupling: 7 Hz to 100 kHz −3 dB (low cut-off frequency: 7 Hz±50%)
Noise	500 μV p-p (typ.), 1 mV p-p (max.) (highest sensitivity range, with input shorted)
Common mode rejection ratio	80 dB or more (at 50 Hz/60 Hz and with signal source resistance 100 Ω or less)
Low-pass filter	Off, 5±50%, 50±50%, 500±50%, 5 k±50%, 50 k±50% (Hz) −3 dB
Anti-aliasing filters	Cutoff frequency (fc) 20, 40, 80, 200, 400, 800, 2 k, 4 k, 8 k, 20 k, 40 k (Hz) (Automatic setting when the anti-aliasing filter is ON) Attenuation property: −66 dB or higher at 1.5 fc
Input type	Unbalanced input (floating)
Input coupling	AC/DC/GND
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
A/D resolution	16 bits
Maximum sampling rate	1 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 V DC
Maximum rated voltage to earth	300 V AC, DC (between individual input channels and enclosure as well as between individual input channels) Measurement category II (anticipated transient overvoltage: 2500 V)
Operating temperature and humidity	As per Memory HiCorder in which Model 8968 is installed
Operating environment	As per Memory HiCorder in which Model 8968 is installed
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)
Effect of radiated radio-frequency electromagnetic field	±15% f.s. (max.) at 3 V/m

Effect of conducted radio-frequency electromagnetic field	±20% f.s. (max.) at 3 V (100 mV/div range, with 1 V DC input)
Standards	Safety EN61010 EMC EN61326 Class A
Options	Model L9197 Connection Cord (CAT IV 300 V, CAT III 600 V, 1 A) Model L9198 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9217 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9790 Connection Cord (with Model L9790-01 or 9790-03: CAT III 300 V, CAT II 600 V, 1 A) (with Model 9790-02: CAT III 150 V, CAT II 300 V, 1 A) Model 9322 Differential Probe (with grabber clips attached: CAT II 1000 V) (with alligator clips attached: CAT III 600 V, CAT II 1000 V) Model P9000-01 Differential Probe (CAT III 1000 V) Model P9000-02 Differential Probe (CAT III 1000 V) Model 9665 10:1 Probe (CAT II 300 V) Model 9666 100:1 Probe (CAT II 300 V)

18.6.4 Model 8969 Strain Unit, U8969 Strain Unit

	Model 8969	Model U8969
Product warranty period	1 year	3 years
Conditions of guaranteed accuracy	• Guaranteed accuracy period: 1 year • Temperature and humidity for guaranteed accuracy: 23°C ±5°C (73°F ±9°F), 20% RH to 80% RH • Warm-up time: At least 30 minutes • Specified after performing the auto-balance	• Guaranteed accuracy period: 1 year • Guaranteed accuracy period from adjustment made by Hioki: 1 year • Temperature and humidity for guaranteed accuracy: 23°C ±5°C (73°F ±9°F), 80% RH or less • Warm-up time: At least 30 minutes • Specified after performing the auto-balance
Number of input channels	2 channels	
Input terminals	Weidmüller SL3.5/7/90G	NDIS connector EPRC07-R9FNDIS
Measurement device	Strain gauge transducer	
Gauge ratio	2.0	
Bridge voltage	2 V ±0.05 V	
Bridge resistance	120 Ω to 1 kΩ	
Balance adjustment range	±10000 με or less	
Balancing method	Electronic auto-balancing	
Measurement range	20, 50, 100, 200, 500, 1000 με/div	
Measurement accuracy	±0.5% f.s. ±4 με (with the low-pass filter set to 5 Hz)	
Temperature characteristics	Gain: ±0.05% f.s./°C Zero position: ±2.5 με/°C	
Frequency characteristic	DC to 20 kHz +1/−3 dB	
Low-pass filter	Off, 5±30%, 10±30%, 100±30%, 1 k±30% (Hz) −3 dB	
A/D resolution	16 bits (±f.s. equals ±25000 pieces of data)	
Maximum sampling rate	200 kS/s	
Maximum rated voltage to earth	33 V AC rms or 70 V DC (between each input channel and enclosure, between any two of input channels) Anticipated transient overvoltage: 330 V (Based on EN61010-2-030:2010)	30 V AC rms or 60 V DC (between each input channel and enclosure, between any two of input channels) Anticipated transient overvoltage: 330 V
Operating temperature and humidity	In accordance with the specifications of Memory HiCorder in which Model 8969 is installed	Temperature: −10°C to 40°C (14°F to 104°F) Humidity: 90% RH or less (no condensation)
Storage temperature and humidity	In accordance with the specifications of Memory HiCorder in which Model 8969 is installed	Temperature: −20°C to 50°C (−4°F to 122°F) Humidity: 80% RH or less (no condensation)
Operating environment	In accordance with the specifications of Memory HiCorder in which Model 8969 is installed	Indoors, Pollution Degree 2, altitude up to 2000 m (6562 ft.)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)	
Mass	Approx. 220 g (7.8 oz.)	Approx. 245 g (8.6 oz.)

Accessories	Model 9769 Conversion Cable × 2 (Compatible connector: NDIS connector PRC03-12A10-7M10.5)	Model L9769 Conversion Cable × 2 (Compatible connector: NDIS connector PRC03-12A10-7M10.5)
Effect of radiated radio-frequency electromagnetic field	±10% f.s. (at a maximum) at 3 V/m (with the low-pass filter set to 5 Hz)	
Effect of conducted radio-frequency electromagnetic field	±10% f.s. (at a maximum) at 3 V (with the low-pass filter set to 5 Hz)	
Standards	Safety: EN61010 EMC: EN61326 Class A	

18.6.5 Model 8970 Freq Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and operated 30 minutes after power on.

Product warranty period	3 years
Measurement functions	The following measurements based on voltage input: frequency, rotation speed, power frequency, count, pulse duty ratio, and pulse width
Input terminals	Insulated BNC terminal
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF
Maximum input voltage	400 V DC
Maximum rated voltage to earth	300 V AC/DC (Measurement category II) Anticipated transient overvoltage: 2500 V (between individual input channels and enclosure as well as between individual input channels)
Input type	Unbalanced input (floating)
Guaranteed accuracy period	1 year
Frequency mode	
Measurement range	1, 5, 10, 50, 100, 500, 1 k, 5 kHz/div (f.s.= 20 div)
Measurement accuracy	±0.1% f.s. (except for 5 kHz/div range) ±0.7% f.s. (5 kHz/div range)
Measurable range	DC to 100 kHz (minimum pulse width: 2 μs
Rotation speed mode	
Measurement range	100, 500, 1 k, 5 k, 10 k, 50 k, 100 kr/min /div (f.s.= 20 div)
Measurement accuracy	±0.1% f.s. (except for 100 kr/min range) ±0.7% f.s. (100 kr/min range)
Measurable range	0 Mr/min to 2 Mr/min (minimum pulse width 2: μs)
Power frequency mode	
Measurement range	50 Hz (40 Hz to 60 Hz), 60 Hz (50 Hz to 70 Hz), 400 Hz (390 Hz to 410 Hz) (f.s. = 20 div)
Measurement accuracy	±0.03 Hz (50 Hz, 60 Hz), ±0.1 Hz (400 Hz)
Count mode	
Measurement range	2 k, 10 k, 20 k, 100 k, 200 k, 1 M counts/div
Measurement accuracy	±range/2000
Measurable range	DC to 100 kHz (minimum pulse width: 2 μs)
Duty ratio mode	
Measurement range	5%/div (f.s.= 20 div)
Measurement accuracy	±1% (10 Hz to 10 kHz) ±4% (10 kHz to 100 kHz)
Measurable range	10 Hz to 100 kHz (minimum pulse width: 2 μs)
Pulse width mode	
Measurement range	500 μ, 1 m, 5 m, 10 m, 50 m, 100 ms/div (f.s.=20 div)
Measurement accuracy	±0.1% f.s.
Measurable range	2 μs to 2 s

Measurement resolution	Count mode: 2000LSB/div (f.s. = 20 div) Except for count mode and power frequency mode: 500LSB/div (f.s. = 20 div) Power frequency mode: 100LSB/div (f.s. = 20 div)
Response time	Within 40 μs + sampling interval of instrument in which the module is installed.
Input voltage range	±10 V, ±20 V, ±50 V, ±100 V, ±200 V, ±400 V
Threshold value	±10 V range: −10 V to +10 V variable (0.1-V step) ±20 V range: −20 V to +20 V variable (0.2-V step) ±50 V range: −50 V to +50 V variable (0.5-V step) ±100 V range: −100 V to +100 V variable (1-V step) ±200 V range: −200 V to +200 V variable (2-V step) ±400 V range: −400 V to +400 V variable (5-V step)
Slope	Rising, falling (Frequency, rotation speed, power frequency, count mode)
Level	High, Low (Duty ratio mode, pulse width mode)
Hold	Frequency mode/Rotation speed mode: ON, OFF (1 Hz, 0.5 Hz, 0.2 Hz, 0.1 Hz) When OFF is selected: If the next measurement value is not determined within the waiting time period, the frequency or the rotation speed will be determined using the value that is calculated based on the time period between the timing of the last measurement and the timing of the sampling. If these calculated values are less than the specified values, then use 0.
Smoothing	OFF, ON (The permissible smoothing frequency is up to 10 kHz.) (Frequency mode, rotation speed mode)
Low-pass filter	OFF, 5, 50, 500, 5 k, 50 kHz
Input coupling	DC, AC (Low frequency cut-off in AC-coupled mode: 7 Hz)
Frequency dividing function	Setting range: 1 to 4096, by one step (Frequency, rotation speed, count mode)
Counting start timing	Start, trigger (Count mode)
Count over handling	Hold, back (Count mode)
Operating temperature and humidity	As per Memory HiCorder in which Model 8970 is installed
Operating environment	As per Memory HiCorder in which Model 8970 is installed
Storage temperature and humidity	As per Memory HiCorder in which Model 8970 is installed
Standards	Safety EN61010 EMC EN61326 Class A
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)
Options	Model L9197 Connection Cord (CAT IV 300 V, CAT III 600 V, 1 A) Model L9198 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9217 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9790 Connection Cord (with Model L9790-01 or 9790-03: CAT III 300 V, CAT II 600 V, 1 A) (with Model 9790-02: CAT III 150 V, CAT II 300 V, 1 A) Model 9322 Differential Probe (with grabber clips attached: CAT II 1000 V) (with alligator clips attached: CAT III 600 V, CAT II 1000 V) Model P9000-01 Differential Probe (CAT III 1000 V) Model P9000-02 Differential Probe (CAT III 1000 V) Model 9665 10:1 Probe (CAT II 300 V) Model 9666 100:1 Probe (CAT II 300 V)

18.6.6 Model 8971 Current Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Applicable current sensors	• Models 9272-10, 9277, 9278, 9279, 9709, CT6841, CT6843, CT6844, CT6845, CT6846*[2], CT6862, CT6863, CT6865*[2] (Model 9318 Conversion Cable is required to connect a sensor with Model 8971.) • Models 9272-05, 9709-05, CT6862-05, CT6863-05, CT6865-05*[2], CT6841-05, CT6843-05, CT6844-05, CT6845-05, CT6846-05*[2], CT6875, CT6876*[2] (Model 9318 Conversion Cable+Model CT9901 Conversion Cable are required to connect a sensor with Model 8971.) • Hioki current sensors with RM515EPA-10PC (Hirose) installed (Supported conversion ratios: 2 V/20 A, 2 V/50 A, 2 V/200 A, 2 V/500 A, 2 V/1000 A*[2])
Measurement range	• When Model 9272-10 (20 A), 9272-05 (20 A), 9277, CT6841, or CT6841-05 is used: 100 m, 200 m, 500 m, 1, 2, 5 A/div • When Model CT6862 or CT6862-05 is used: 200 m, 500 m, 1, 2, 5, 10 A/div • When Model 9272-10 (200 A), 9272-05 (200 A), 9278, CT6843, CT6843-05, CT6863, or CT6863-05 is used: 1, 2, 5, 10, 20, 50 A/div • When Model 9279, 9709, 9709-05, CT6844, CT6844-05, CT6845, CT6845-05, CT6846*[2], CT6846-05*[2], CT6865*[2], CT6865-05*[2], CT6875, or CT6876*[2] is used: 2, 5, 10, 20, 50, 100 A/div
Measurement accuracy*[1]	±0.65% f.s. (Filter 5 Hz On) ±0.85% f.s. (Filter 5 Hz On, for using with Model 9278 or 9279)
RMS accuracy*[1]	±1% f.s. (DC, 30 Hz to 1 kHz), ±3% f.s. (1 kHz to 10 kHz) (Sine wave input, filter 5 Hz On, crest factor 2)
Response time*[1]	100 ms (rising from 0% f.s. to 90% f.s.)
Temperature characteristic*[1]	±0.075% f.s./°C
Frequency characteristic*[1]	DC Coupling: DC to 100 kHz ±3 dB AC Coupling: 7 Hz to 100 kHz ±3 dB (low cut-off frequency: 7 Hz±50%)
Noise*[1]	10 mA p-p max. (Highest sensitivity range, with input shorted) (for 20 A/2V range)
Low-pass filter	OFF, 5, 50, 500, 5 k, 50 k±50% (Hz) −3 dB
Input type	Unbalanced input (Not insulated)
Input coupling	AC/DC/GND
Input resistance	1 MΩ±1%
A/D resolution	12 bits
Maximum sampling rate	1 MS/s
Input terminals	Sensor connector HR10A-10R-S (Hirose)
Operating temperature and humidity	As per Memory HiCorder in which Model 8971 is installed
Operating environment	As per Memory HiCorder in which Model 8971 is installed

Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)
Standards	Safety EN61010 EMC EN61326 Class A
Accessories	For connecting the clamp sensor: Model 9318 Conversion Cable × 2
Options	Model 9318 Conversion Cable, Model CT9901 Conversion Cable
Number of the 8971 available for Memory HiCorder	Up to 4 modules

*1 For current measurement, add the accuracy and characteristic of the clamp sensor used with Model 8971.

*2 The instrument recognizes this as a 500 A AC/DC sensor is connected; setting the ratio of the scaling function to 2 is required.

18.6.7 Model 8972 DC/RMS Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Measurement range	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	±0.5% f.s. (Filter 5 Hz On)
RMS accuracy	±1% f.s. (DC, 30 Hz to 1 kHz), ±3% f.s. (1 kHz to 100 kHz) (Sine wave input, response time: Slow)
Response time	Slow 5 s (rising from 0% f.s. to 90% f.s.) Normal 800 ms (rising from 0% f.s. to 90% f.s.) Fast 100 ms (rising from 0% f.s. to 90% f.s.)
Crest factor	2
Temperature characteristic	±0.045% f.s./°C
Frequency characteristic	DC Coupling: DC to 400 kHz −3 dB AC Coupling: 7 Hz to 400 kHz −3 dB (low cut-off frequency: 7 Hz±50%)
Noise	500 μV p-p (typ.), 750 μV p-p (max.) (Highest sensitivity range, with input shorted)
Common mode rejection ratio	80 dB or more (at 50 Hz/60 Hz and with signal source resistance 100 Ω or less)
Low-pass filter	Off, 5±50%, 50±50%, 500±50%, 5 k±50%, 100 k±50% (Hz) −3 dB
Input type	Unbalanced input (floating)
Input coupling	AC/DC/GND
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
A/D resolution	12 bits
Maximum sampling rate	1 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 V DC
Maximum rated voltage to earth	300 V AC, DC (between individual input channels and enclosure as well as between individual input channels) Measurement category II (anticipated transient overvoltage: 2500 V)
Operating temperature and humidity	As per Memory HiCorder in which Model 8972 is installed
Operating environment	As per Memory HiCorder in which Model 8972 is installed
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)

Effect of radiated radio-frequency electromagnetic field	±15% f.s. (max.) at 3 V/m
Effect of conducted radio-frequency electromagnetic field	±20% f.s. (max.) at 3 V (100 mV/div range, with 1 V DC input)
Standards	Safety EN61010 EMC EN61326 Class A
Options	Model L9197 Connection Cord (CAT IV 300 V, CAT III 600 V, 1 A) Model L9198 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9217 Connection Cord (CAT III 300 V, CAT II 600 V, 0.2 A) Model L9790 Connection Cord (with Model L9790-01 or 9790-03: CAT III 300 V, CAT II 600 V, 1 A) (with Model 9790-02: CAT III 150 V, CAT II 300 V, 1 A) Model 9322 Differential Probe (with grabber clips attached: CAT II 1000 V) (with alligator clips attached: CAT III 600 V, CAT II 1000 V) Model P9000-01 Differential Probe (CAT III 1000 V) Model P9000-02 Differential Probe (CAT III 1000 V) Model 9665 10:1 Probe (CAT II 300 V) Model 9666 100:1 Probe (CAT II 300 V)

18.6.8 Model 8973 Logic Unit

Product warranty period	3 years
Number of input channels	4 probes (16 channels)
Input terminals	Mini DIN
Applicable probes	Model 9320-01 Logic Probe, Model MR9321-01 Logic Probe, Model 9327 Logic Probe
Operating temperature and humidity	As per Memory HiCorder in which Model 8973 is installed
Operating environment	As per Memory HiCorder in which Model 8973 is installed
Storage temperature and humidity	-20°C to 50°C (-4°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 190 g (6.7 oz.)
Standards	Safety EN61010 EMC EN61326 Class A

18.6.9 Model MR8990 Digital Voltmeter Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and calibration is executed 30 minutes after power on.

<table>
<tr><td><b>Product warranty period</b></td><td>3 years</td></tr>
<tr><td><b>Guaranteed accuracy period</b></td><td>1 year</td></tr>
<tr><td><b>Number of input channels</b></td><td>2 channels</td></tr>
<tr><td><b>Measurement item</b></td><td>DC voltage</td></tr>
<tr><td><b>Measurement range</b></td><td>
<table>
<tr><th>Measurement range</th><th>Effective input range*</th><th>Maximum resolution</th><th>Input resistance</th></tr>
<tr><td>5 mV/div (f.s.= 100 mV)</td><td>-120 mV to 120 mV</td><td>0.1 μV</td><td rowspan="3">100 MΩ or more</td></tr>
<tr><td>50 mV/div (f.s.= 1000 mV)</td><td>-1200 mV to 1200 mV</td><td>1 μV</td></tr>
<tr><td>500 mV/div (f.s.= 10 V)</td><td>-12 V to 12 V</td><td>10 μV</td></tr>
<tr><td>5 V/div (f.s.= 100 V)</td><td>-120 V to 120 V</td><td>100 μV</td><td rowspan="2">10 MΩ±5%</td></tr>
<tr><td>50 V/div (f.s.= 1000 V)</td><td>-500 V to 500 V</td><td>1 mV</td></tr>
</table>
* Guaranteed range of measurement accuracy</td></tr>
<tr><td><b>Measurement accuracy</b></td><td>
<table>
<tr><th>Measurement range</th><th>NPLC: Less than 1</th><th>NPLC: 1 or more</th></tr>
<tr><td>5 mV/div (f.s.= 100 mV)</td><td>±0.01% rdg.±0.015% f.s.</td><td>±0.01% rdg.±0.01% f.s.</td></tr>
<tr><td>50 mV/div (f.s.= 1000 mV)</td><td colspan="2" rowspan="2">±0.01% rdg.±0.0025% f.s.</td></tr>
<tr><td>500 mV/div (f.s.= 10 V)</td></tr>
<tr><td>5 V/div (f.s.= 100 V)</td><td colspan="2" rowspan="2">±0.025% rdg.±0.0025% f.s.</td></tr>
<tr><td>50 V/div (f.s.= 1000 V)</td></tr>
</table>
</td></tr>
<tr><td><b>Temperature characteristic</b></td><td>±(0.002% rdg. + 0.00025% f.s.)/°C</td></tr>
<tr><td><b>A/D conversion measurement method</b></td><td>Δ Σ modulation method</td></tr>
<tr><td><b>Integration time</b></td><td>
<table>
<tr><th>Power Frequency</th><th>Integration time</th></tr>
<tr><td>50 Hz</td><td>20 ms × NPLC</td></tr>
<tr><td>60 Hz</td><td>16.67 ms × NPLC</td></tr>
</table>
NPLC: Settable from 0.1 to 0.9 (in increments of 0.1), 1 to 9 (in increments of 1), 10 to 100 (in increments of 10)</td></tr>
<tr><td><b>Response time</b></td><td>Within 2 ms + 2 × integration time (rising from −f.s. to +f.s., falling from +f.s. to −f.s.)</td></tr>
<tr><td><b>Fast response</b></td><td>ON/ OFF</td></tr>
<tr><td><b>Common mode rejection ratio</b></td><td>100 dB or more (at 50 Hz/60 Hz and with signal source resistance 100 Ω or less)</td></tr>
<tr><td><b>Input type</b></td><td>Unbalanced input (floating)</td></tr>
<tr><td><b>Input terminals</b></td><td>Banana jacks</td></tr>
<tr><td><b>Maximum input voltage</b></td><td>500 V DC</td></tr>
<tr><td><b>Maximum rated voltage to earth</b></td><td>300 V AC, DC (between individual input channels and enclosure as well as between individual input channels)
Measurement category II (anticipated transient overvoltage: 2500 V)</td></tr>
<tr><td><b>Operating temperature and humidity</b></td><td>As per Memory HiCorder in which Model MR8990 is installed</td></tr>
</table>

Operating environment	As per Memory HiCorder in which Model MR8990 is installed
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 260 g (9.2 oz.)
Effect of radiated radio-frequency electromagnetic field	±0.1% f.s. (max.) at 3 V/m (in 5 mV/div range)
Standards	Safety EN61010 EMC EN61326 Class A
Option	Model L2200 Test Lead (CAT IV 600 V, CAT III 1000 V, 10 A)

18.6.10 Model U8974 High Voltage Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 20% RH to 80% RH, and zero adjustment is executed 30 minutes after power on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Measurement functions	Instantaneous value, r.m.s. value (can be changed for each channel)
Measurement range	200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, 20 V, 50 V/div (mode DC) 500 mV, 1 V, 2 V, 5 V, 10 V, 20 V, 50 V/div (mode RMS)
Measurement accuracy	±0.25% f.s. (Filter 5 Hz On)
RMS measurement accuracy	±1.5% f.s. (DC, 30 Hz to 1 kHz, sine waves, response time: slow) ±3% f.s. (1 kHz to 10 kHz, sine waves) Crest factor: 2 (sine waves, the peak voltage is up to 1000 V)
RMS measurement response time	Fast: 150 ms (rising from 0% f.s. to 90% f.s.) Normal: 500 ms (rising from 0% f.s. to 90% f.s.) Slow: 2.5 s (rising from 0% f.s. to 90% f.s.)
Temperature characteristic	±0.05% f.s./°C
Frequency characteristic	DC to 100 kHz −3 dB
Noise	30 mV p-p (typ.), 50 mV p-p (max.) (highest sensitivity range, with input shorted)
Common mode rejection ratio	80 dB or more (50 Hz/60 Hz input shorted)
Low-pass filter	OFF, 5±50%, 50±50%, 500±50%, 5 k±50%, 50 k±50% (Hz) -3 dB
Input type	Unbalanced input (floating)
Input coupling	DC/GND
Input resistance	4 MΩ±1%
Input capacitance	5 pF or less (at 100 kHz)
A/D resolution	16 bits
Maximum sampling rate	1 MS/s
Input terminals	Banana jacks
Maximum input voltage	1000 V DC, 700 V AC
Maximum rated voltage to earth	1000 V AC, DC measurement category III, 600 V AC, DC measurement category IV (between each input channel and chassis, between input channels) Anticipated transient overvoltage: 8000 V
Operating temperature and humidity	As per Memory HiCorder in which Model U8974 is installed
Operating environment	As per Memory HiCorder in which Model U8974 is installed

Storage temperature and humidity	Temperature -20°C to 50°C (-4°F to 122°F) Humidity not lower than -20°C but lower than 40°C (not lower than -4°F but lower than 104°F) 80% RH or less (no condensation) not lower than 40°C but lower than 45°C (not lower than 104°F but lower than 113°F) 60% RH or less (no condensation) not lower than 45°C but not higer than 50°C (not lower than 113°F but not higer than 122°F) 50% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 230 g (8.1 oz.)
Effect of radiated radio-frequency electromagnetic field	±5% f.s. (max.) at 3 V/m
Effect of conducted radio-frequency electromagnetic field	±5% f.s. (max.) at 3 V (500 mV/div range, with 1 V DC input)
Standards	Safety EN61010 EMC EN61326 Class A
Options	Model L4940 Connection Cable Set (1.5 m) Model L4935 Alligator Clip Set (mounted on the tips of L4940, CAT IV 600 V, CAT III 1000 V, 10 A) Model L9243 Grabber Clip (mounted on the tips of L4940, CAT II 1000 V, 1 A) Model L4936 Bus Bar Clip Set (mounted on the tips of L4940, CAT III 600 V, 5 A) Model L4937 Magnetic Adapter Set (mounted on the tips of L4940, CAT III 1000 V, 2 A) Model L4931 Extension Cable (for L4940, 1.5 m, CAT IV 600 V, CAT III 1000 V, 10 A) Model L4932 Test Pin Set (mounted on the tips of L4940, CAT IV 600 V, CAT III 1000 V, 10 A) Model L4934* Small Alligator Clip Set (CAT III 300 V, CAT II 600 V, 3 A) * Model L4932 is necessary when using Model L4934.

18.6.11 Model U8979 Charge Unit

1. General specifications

Operating environment	Indoors, Pollution Degree 2, Operating altitude: up to 2000 m (6562 ft.)
Operating temperature and humidity	0°C to 40°C (32°F to 104°F), 80% RH or less (no condensation)
Storage temperature and humidity	−10°C to 50°C (14°F to 122°F) For −10°C or higher but lower than 40°C (14°F or higher but lower than 104°F), 80% RH or less (no condensation) For 40°C or higher but lower than 45°C (104°F or higher but lower than 113°F), 60% RH or less (no condensation) For 45°C to 50°C (113°F to 122°F), 50% RH or less (no condensation)
Standards	Safety: EN61010 EMC: EN61326 Class A
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D)
Mass	Approx. 250 g (8.8 oz.)
Product warranty period	3 years
Guaranteed accuracy period	1 year
Option	Model 9166 Connection Cord (for voltage measurement)

2. Specifications of input, output, and measurement

-1. Common specifications

Number of channels	2 channels
Measurement mode	Charge, pre-amplifier, voltage (selectable for each channel)
Input type	Unbalanced input (floating) In each channel, the voltage input terminal has the same-potential ground as the charge input terminal.
Common-mode rejection ratio	80 dB or more (at 50 Hz / 60 Hz, a signal source resistance of 100 Ω)
Anti-aliasing filters	Cutoff frequency (fc): 20, 40, 80, 200, 400, 800, 2 k, 4 k, 8 k, 20 k, 40 k (Hz) Switchable between on and off; the instrument automatically chooses a cutoff frequency along with the sampling rate. Attenuation property: −66 dB or higher at a cutoff frequency of 1.5 fc
Maximum sampling rate	200 kS/s
A/D resolution	16 bits (± f.s. = ±25,000 data points)
Maximum rated voltage to earth	30 V AC, 60 V DC (between each input channel and the enclosure, between any two of input channels) Anticipated transient overvoltage: 330 V

-2. Voltage input

Measurement range	10, 20, 40, 100, 200, 400 mV f.s., 1, 2, 4, 10, 20, 40 V f.s.
Maximum input voltage	40 V DC

Frequency characteristics	DC to 50 kHz −3 dB (DC-coupled) 1 Hz to 50 kHz −3 dB (AC-coupled, lower cutoff frequency: 1 Hz ±50%)
Noise	80 μV p-p (typ.), 120 μV p-p (max.), with the highest sensitivity range and the terminals of each input connector connected with each other
Input resistance	1 MΩ ±1%
Input capacitance	200 pF or less (at 100 kHz)
Input coupling	AC/DC/GND
Input terminals	Metallic BNC terminal

-3. Charge input

Supported detector	Charge-output acceleration detector
Measurement sensitivity	0.1 pC/(m/s^2) to 10 pC/(m/s^2)
Measurement range	40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 k, 200 k m/s^2 f.s. Measurement sensitivity: 0.1 pC/(m/s^2) to 0.25 pC/(m/s^2) 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 k m/s^2 f.s. Measurement sensitivity: 0.251 pC/(m/s^2) to 0.5 pC/(m/s^2) 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k m/s^2 f.s. Measurement sensitivity: 0.501 pC/(m/s^2) to 1.0 pC/(m/s^2) 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k m/s^2 f.s. Measurement sensitivity: 1.001 pC/(m/s^2) to 2.5 pC/(m/s^2) 2, 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k m/s^2 f.s. Measurement sensitivity: 2.501 pC/(m/s^2) to 5.0 pC/(m/s^2) 1, 2, 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k m/s^2 f.s. Measurement sensitivity: 5.001 pC/(m/s^2) to 10.0 pC/(m/s^2)
Frequency characteristics	1.5 Hz to 50 kHz −3 dB
Maximum input charge	±500 pC (when one of the higher six ranges is chosen) ±50,000 pC (when one of the lower six ranges is chosen)
Input coupling	AC/GND
Input terminals	Miniature connector (#10-32UNF)

-4. Input from acceleration sensor with the built-in pre-amplifier

Supported detector	Acceleration detector with built-in pre-amplifier
Measurement sensitivity	0.1 mV/(m/s^2) to 10 mV/(m/s^2)
Measurement range	40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 k, 200 k m/s^2 f.s. Measurement sensitivity: 0.1 mV/(m/s^2) to 0.25 mV/(m/s^2) 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 k m/s^2 f.s. Measurement sensitivity: 0.251 mV/(m/s^2) to 0.5 mV/(m/s^2) 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k m/s^2 f.s. Measurement sensitivity: 0.501 mV/(m/s^2) to 1.0 mV/(m/s^2) 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k m/s^2 f.s. Measurement sensitivity: 1.001 mV/(m/s^2) to 2.5 mV/(m/s^2) 2, 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k, 10 k m/s^2 f.s. Measurement sensitivity: 2.501 mV/(m/s^2) to 5.0 mV/(m/s^2) 1, 2, 4, 10, 20, 40, 100, 200, 400, 1 k, 2 k, 4 k m/s^2 f.s. Measurement sensitivity: 5.001 mV/(m/s^2) to 10.0 mV/(m/s^2)
Frequency characteristics	1 Hz to 50 kHz −3 dB

Power supply for detector	3.0 mA ±20%, 22 V ±5%
Input coupling	AC/GND
Input terminals	Metallic BNC terminal

-5. Specifications for accuracy

Conditions of guaranteed accuracy	Guaranteed accuracy period: 1 year Guaranteed accuracy period after adjustment made by Hioki: 1 year Temperature and humidity for guaranteed accuracy: 23°C ±5°C (73°F ±9°F), 80% RH or less Warm-up time: 30 minutes or more Specified after execution of zero-adjustment
Accuracy of voltage measurement	±0.5% f.s. (with the filter set at 5 Hz)
Temperature characteristic of voltage measurement	±0.05% f.s./°C
Accuracy of amplitude with charge inputted	±2% f.s.
Temperature characteristic with charge inputted	±0.2% f.s./°C
Accuracy of amplitude inputted from acceleration detector with built-in pre-amplifier	±2% f.s.
Temperature characteristics of input from acceleration sensor with the built-in pre-amplifier	±0.2% f.s./°C
Effect of radiated radio-frequency electromagnetic field	±10% f.s. (max.) at 3 V/m (with the filter set at 5 Hz)
Effect of conducted radio-frequency electromagnetic field	±10% f.s. (max.) at 3 V (with the filter set at 5 Hz)

3. Specifications of functions

Low-pass filter	Off, 5 ±50% (voltage input only), 500 ±50%, 5k ±50% (Hz) −3 dB
TEDS	IEEE1451.1.4 Class 1 compliant The instrument reads out sensor information to automatically configure the sensitivity setting.

18.6.12 U8793 Arbitrary Waveform Generator Unit

General Specifications

Operating environment	As per Memory HiCorder in which Model U8793 is installed
Operating temperature and humidity	As per Memory HiCorder in which Model U8793 is installed
Storage temperature and humidity	-20°C to 50°C (-4°F to 122°F), 80% RH or less (no condensation)
Standards	Safety EN61010 EMC EN61326 Class A
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D) (excluding protrusions)
Mass	Approx. 250 g (8.8 oz.)
Product warranty period	3 years
Options	Model L9795-01 Connection Cable (terminal type: SMB terminal/mini-alligator clip) Model L9795-02 Connection Cable (terminal type: SMB terminal/BNC terminal)

Output Specifications

Basic Specifications (common for FG function and arbitrary waveform generation function)

Conditions of guaranteed accuracy	Guaranteed accuracy period: 1 year Guaranteed accuracy period from adjustment made by Hioki: 1 year Temperature and humidity for guaranteed accuracy: 23°C±5°C (73°F±9°F), 80% RH or less Warm-up time: at least 30 min. Power supply frequency range for Memory HiCorder in which Model U8793 is installed: 50 Hz/60 Hz±2 Hz
Number of output channels	2 channels
Output terminals	SMB terminals
Output type	Unbalanced output (floating)
Maximum rated voltage to earth	30 V rms AC or 60 V DC (between individual output channels and enclosure/external I/O terminals as well as between individual output channels) Anticipated transient overvoltage: 330 V
Maximum output voltage	-10 V to 15 V
Amplitude setting range	0 V p-p to 20 V p-p (setting resolution: 1 mV)
DC offset setting range	-10 V to 15 V (setting resolution: 1 mV)
Output impedance	1 Ω or less
Maximum output current	±10 mA (per channel)
Allowable load resistance	1.5 kΩ or greater
Output format	Waveform output/open/short

FG Function Specifications

Output waveform	Sine wave, rectangular wave, pulse wave (variable duty ratio), triangular wave, ramp wave, DC
Output frequency range	0 Hz to 100 kHz (setting resolution: 10 mHz)
Output frequency accuracy	±0.015% of setting
DC output accuracy	±0.05% of setting±10 mV
DC output temperature characteristic	(±0.005% of setting±1 mV)/°C
Amplitude accuracy	±0.5% of setting±10 mV p-p (not lower than 10 mHz but not higher 10 kHz) ±0.8% of setting±10 mV p-p (higher than 10 kHz but not higher than 50 kHz) ±1.0% of setting±10 mV p-p (higher than 50 kHz but not higher than 100 kHz)
Amplitude temperature characteristic	(±0.05% of setting±1 mV p-p)/°C
DC offset accuracy	±0.5% of setting±10 mV
DC offset Temperature characteristic	(±0.05% of setting±1 mV)/°C
Phase difference setting range	-360° to 360° (setting resolution: 0.1°)
Jitter	Within 50 ns p-p (rectangular waves, pulse waves, triangular waves, ramp waves)
Pulse waves duty ratio setting range	0.1% to 99.9% (setting resolution: 0.1%) Valid with a pulse width of 500 ns or greater
Pulse waves duty ratio accuracy	±0.1% of period (not lower than 10 mHz but not higher than 5 kHz) ±0.5% of period (higher than 5 kHz but not higher than 20 kHz) ±1.0% of period (higher than 20 kHz but not higher than 100 kHz)

Specifications for Arbitrary Waveform Generation Function

Output waveform	Waveforms measured with the 8847, MR8847, MR8847A, MR8827, MR8740, or MR8741 Memory HiCorder (Logic waveforms are not supported.) Waveforms measured with the PW3198 Power Quality Analyzer (via SF8000) Waveforms saved by the 7075 Waveform Generator (via SF8000) Waveforms created in CSV format (via SF8000) Waveforms created with Model SF8000 Waveform Maker
Voltage axis resolution	16 bits
Waveform memory capacity	256 kW/channel × 8 blocks
Low-pass filter	2nd-order LPF, 50 Hz to 1 MHz (14 steps in 1-2-5 progression)
D/A refresh rate	Max. 2 MHz (setting resolution:10 mHz)
Clock frequency accuracy	±150 ppm
Clock frequency jitter	Within 50 ns p-p
Delay	-250,000 to 250,000 (settable in increments of 1 data point)
Number of loops	1 to 50,000 or ∞

Sweep Function Specifications

Sweep waveforms	Non-DC FG waveforms, arbitrary waveforms
Sweep form	Linear
Sweep target	FG waveforms: Frequency, amplitude, offset, duty ratio (pulse waves only) (Simultaneous sweeping of frequency, amplitude, and offset) Arbitrary waveforms: Clock frequency, amplitude, offset (Simultaneous sweeping of clock frequency, amplitude, and offset)
Sweep time setting range	10 μs to 1000 s (setting resolution: 10 μs)

Program Function Specifications

Sequence length	Output by connecting up to 128 steps
Step control	Ability to set an FG waveform, sweep waveform, or user waveform for each step Ability to set the number of loops (for sweep waveforms) or output time (for FG and arbitrary waveforms) for each step
Hold settings	ON/OFF setting for each step
Output time setting range	10 μs to 1000 s (FG waveforms, arbitrary waveforms)
Step loop count setting range	1 to 1,000 (for sweep waveforms)
Overall loop count setting range	1 to 50,000 or ∞
Monitor functions	Display of step number being executed, step loop count, and overall loop count

Other Specifications

Channel synchronization	Ability to set the phase between channels on the same module and between modules
Self-test function	Ability to monitor output voltage value Monitor resolution: 10 mV Monitor accuracy: ±3.0% f.s. (f.s.=15 V)
Output start/stop	By operating key on the Memory HiCorder or applying a signal to the unit's external control terminal
External input	Cancel hold and transition to next step on low-level signal input from an external source while using the program function. Control voltage level: 3.5 V to 5.0 V (high level), 0 V to 0.8 V (low level) Response pulse width: 100 μs or greater (low level)
External output	Output during waveform output Output format: Open-drain output (with 5 V voltage output, active low) Output voltage level: 4.0 V to 5.0 V (high level), 0 V to 0.5 V (low level) Maximum switching capacity: 5 V DC to 30 V DC, 50 mA
External I/O terminals	Push-button type terminal block
Waveform output indicator	Red LED on during waveform output and off when output is off

18.6.13 MR8790 Waveform Generator Unit

The accuracy is provided for the condition where the module is installed on the Memory HiCorder at 23°C±5°C (73°F±9°F), 80% RH or less (no condensation), and 30 minutes after power on.

General Specifications

Product warranty period	3 years
Guaranteed accuracy period	1 year
Guaranteed accuracy period from adjustment made by Hioki	1 year
Number of output channels	4 channels (all channels isolated from each other and from the enclosure and outputs)
Self-test function	Included (with voltage and current monitor)
Voltage and current monitoring function (switchable)	Resolution: 5 μA (current monitor) 10 mV (voltage monitor) Monitor accuracy:±3.0% f.s. (f.s. = 10 V [voltage monitor] or 5 mA [current monitor])
Maximum output current	±5 mA
Allowable load resistance	2 kΩ or more
Output terminals	SMB terminals
Output configuration	Waveform output/Open/Short circuit
Output relay Switching time	5 ms or less
Output protection	Output current limited to 40 mA (when output is shorted)
Maximum rated voltage to earth	30 V rms AC or 60 V DC (between individual output channels and enclosure as well as between individual output channels) Anticipated transient overvoltage: 330 V
Operating temperature and humidity	As per Memory HiCorder in which Model MR8790 is installed
Operating environment	As per Memory HiCorder in which Model MR8790 is installed
Storage temperature and humidity	-20°C to 50°C (-4°F to 122°F), 90% RH or less (no condensation)
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D) (excluding protrusions)
Mass	Approx. 230 g (8.1 oz.)
Standards	Safety EN61010 EMC EN61326 Class A
Effect of radiated radio-frequency electromagnetic field	±3% f.s. (max.) at 3 V/m (f.s.=10 V)
Effect of conducted radio-frequency electromagnetic field	±1% f.s. (max.) at 3 V (f.s.=10 V)
Options	Model L9795-01 Connection Cable (terminal type: SMB terminal/mini-alligator clip) Model L9795-02 Connection Cable (terminal type: SMB terminal/BNC terminal)

Voltage Output Specifications

Maximum output voltage	±10 V
Resolution	16 bits
Output frequencies	Output frequencies: DC, 0 Hz to 20 kHz (sine waves) Setting resolution: 1 Hz Frequency accuracy: ±0.01% of setting
Amplitude	Setting range: 0 V p-p to 20 V p-p Setting resolution: 1 mV Amplitude accuracy: ±0.25% of setting ±2 mV p-p (not lower than 1 Hz but not higher than 10 kHz) ±0.6% of setting ±2 mV p-p (higher than 10 kHz but not higher than 20 kHz)
DC offset	Setting range: -10 V to 10 V Peak value including amplitude and DC offset is limited to ±10 V. Setting resolution: 1 mV Offset accuracy: ±3 mV
DC output	Output accuracy: ±0.6 mV

18.6.14 MR8791 Pulse Generator Unit

General Specifications

Temperature and humidity for guaranteed accuracy	23°C±5°C (73°F±9°F), 80% RH or less (no condensation) (When installed in the Memory HiCorder)
Guaranteed accuracy period	1 year
Product warranty period	3 years
Operating temperature and humidity	As per Memory HiCorder in which Model MR8791 is installed
Operating environment	As per Memory HiCorder in which Model MR8791 is installed
Storage temperature and humidity	-20°C to 50°C (-4°F to 122°F), 90% RH or less (no condensation)
Maximum rated voltage to earth	30 V rms AC or 60 V DC (between output channel and enclosure) Anticipated transient overvoltage: 330 V
Dimensions	Approx. 106W × 19.8H × 196.5D mm (4.17″W × 0.78″H × 7.74″D) (excluding protrusions)
Mass	Approx. 230 g (8.1 oz.)
Number of output channels	8 (output channels and enclosure isolated; output units isolated) (channels not isolated from each other [common GND]) (channels not isolated from output connector frame [common GND])
Output mode 1	Pattern output/pulse output (switched for all 8 channels at once)
Output mode 2	Logic output/open-collector output (set separately for each of 8 channels)
Logic output:	Output voltage level: 0 V to 5 V (high level 3.8 V or greater, low level 0.8 V or less) Rated current: ±5 mA
Open collector Output:	Collector/emitter absolute maximum rated voltage: 50 V Over-current protection: 100 mA
Output mode 3	Output/open (= self-test) (switched for all 8 channels at once)
Open-collector output definition (rising time [10% to 90%])	5 μs (max.) (load capacity of 1000 pF, pull-up resistance of 1 kΩ)
Self-test function	Detected voltages: High level 3.4 V or greater, low level 1.6 V or less
Relay switching time	5 ms or less (logic/open collector switching, output/open [self-test] switching)
Standards	Safety EN61010 EMC EN61326 Class A

Pulse Output Specifications

Output frequency	Setting range:	0 Hz to 20 kHz (set separately for each of 8 channels)
	Setting resolution:	0.1 Hz
	Frequency accuracy:	±100 ppm
Duty ratio	Setting range:	0.1% to 99.9%, 0, 100% (DC)
	Setting resolution:	0.1%
	Duty ratio accuracy:	{±100 ppm (setting period) ±150 ns} of setting Priority to the “Minimum pulse width” and “Open collector output regulation” specifications
Minimum pulse width	1 μs	

Pattern Output Specifications

Clock frequency	Range: 0 Hz to 120 kHz (Common for 8 channels) Setting resolution: 10 Hz Frequency accuracy: ± 100 ppm of setting
Memory (Pattern)	2,048 words (16,384 bits = 2,048 words × 8 bits/word)

Output Connector Specifications

10250-52A2PL: 3M products (SCSI-2 connector), (Centronics half-pitch 50 pins socket-contact)

Pin	Signal name	Pin	Signal name
1	I_GND	26	I_GND
2	CH1	27	I_GND
3	CH2	28	I_GND
4	CH3	29	I_GND
5	CH4	30	I_GND
6	I_GND	31	I_GND
7	CH5	32	I_GND
8	CH6	33	I_GND
9	CH7	34	I_GND
10	CH8	35	I_GND
11	I_GND	36	I_GND
12	NC	37	I_GND
13	NC	38	I_GND
14	NC	39	I_GND
15	NC	40	I_GND
16	I_GND	41	I_GND
17	NC	42	I_GND
18	NC	43	I_GND
19	NC	44	I_GND
20	NC	45	I_GND
21	I_GND	46	I_GND
22	TEST2 (DIN03)	47	I_GND
23	TEST3 (DIN02)	48	I_GND
24	NC	49	I_GND
25	NC	50	I_GND
Frame	F_GND		

CH1 to CH8:	Pulse output
I_GND:	Isolation GND (insulated GND)
F_GND:	Non-Isolation GND (main instrument GND)
NC:	No Connect
TESTn:	Test pin DO NOT CONNECT

(Recommended) Connection cable KB-SHH2: Sanwa Supply products (SCSI-2 connector), (Centronics half-pitch 50 pins, pin-contact)

19 Maintenance and Service

⚠WARNING

- **Do not touch the internal parts of this instrument as high voltage is generated in some parts. Customers are not allowed to modify, disassemble, or repair the instrument. Doing so may cause fire, electric shock, or injury.**
- **Do not touch the internal parts of this instrument as high voltage is generated in some parts. Customers are not allowed to modify, disassemble, or repair the instrument. Doing so may cause fire, electric shock, or injury.**

The recording paper can be purchased via authorized Hioki distributor or reseller.

Calibrations

The frequency of calibration varies depending on the status of the instrument and installation environment. We recommend that the frequency of calibration be determined in accordance with the status of the instrument and installation environment and that you request that calibration be performed periodically.

Precautions During Shipment

Be sure to observe the following precautions:

- To avoid damage to the instrument, remove all accessories and optional equipment from the instrument. Use the original packing materials in which the product was shipped. Damage that occurs during transport is not covered by the warranty.
- When sending the instrument for repair, be sure to include details of the problem.

To avoid straining some parts of the printer, and to prevent dirt adhering to the print head, close the printer cover.

Replaceable Parts and Operating Lifespan

The characteristics of some parts used in the product may deteriorate due to long time of use.
To ensure the product can be used over the long term, it is recommended to replace these parts on a periodic basis.
Contact your authorized Hioki distributor or reseller for replacement.
The service life of parts varies with the operating environment and frequency of use. Parts are not guaranteed to operate throughout the recommended replacement cycle.

Part	Recommended replacement cycle	Remarks/conditions
Fan motor	Approx. 50,000 hours	—
Power supply	Approx. 40,000 hours	When Model U8350 Printer Unit is installed
Print head	After using approx. 1,000 rolls of recording paper	—
LCD backlight (Half-life of brightness)	Approx. 70,000 hours	At ambient temperature of 25°C The service life varies greatly depending on the ambient environment. The service life becomes shorter under high temperature in particular.
Model U8330 SSD Unit	Approx. 20,000 hours (continuous writing)	In ambient environment of 25°C TBW (Total Byte Written): Approx. 60 TB Data retention period: Approx. one year (When power is OFF) It is recommended to back up the data at regular intervals.
Electrolytic capacitors	Approx. 50,000 hours	PCBs on which an electrolytic capacitor must be replaced.

Part	Recommended replacement cycle	Remarks/conditions
Lithium Battery	Approx. 10 years	The instrument contains a built-in backup lithium battery which offers a service life of about 10 years. If the date and time deviate substantially when the instrument is switched on, the battery should be replaced. Contact your authorized Hioki distributor or reseller.

The fuse is housed in the power unit of the instrument. If the power does not turn on, the fuse may be blown. If this occurs, replacement or repair cannot be performed by the customer. Please contact your dealer or Hioki representative.

19.1 Troubleshooting

If damage is suspected, check this section before contacting your authorized Hioki distributor or reseller.

Before Having the Instrument Repaired

If Power and Operating Keys Malfunction

Symptom	Cause or Item to check	Remedy and reference
The display does not appear when you turn the power on.	Is the power cord disconnected? Are connections made correctly?	Verify that the power cord is connected properly. “2.5 Power Supply” (p. 50)
Keys do not work.	• Is any key being held down? • Is the key-lock state active (Key-Lock message displayed)?	Verify key operation. Deactivate the key-lock state. (Hold the **ESC** keys for three seconds)

If the Display or Operations Malfunction

Symptom	Cause or Item to check	Remedy and reference
Blank screen	Is the backlight saver active? Press any key to check.	Turn the backlight saver off.
No waveform appears when you press the **START** key.	• Is the “Pre-Trigger wait” message displayed? • Is the “Trigger wait” message displayed?	When pre-triggering is enabled, triggering is ignored until the pre-trigger portion of the waveform has been acquired. Recording starts when a trigger occurs.
No changes occur in the displayed waveform.	• Is the clamp sensor or connection cable connected correctly? • Is the vertical axis (voltage axis) range set properly? • Is the low-pass filter enabled?	Verify that the clamp sensor or connection cable is connected correctly. Verify the input channel settings.
While measuring with the memory function, the displayed frequency is much lower than the actual frequency.	Aliasing may be occurring.	Change the timebase to use a faster sampling rate. Press the **AUTO** key to try automatic setting. “3.3.2 Timebase and Sampling Rate” (p. 60)
The displayed waveform size does not change when the input range is changed.	Is the Variable function **[On]**?	Turn the Variable function **[Off]**. “8.6 Set the Waveform Position (Variable Function)” (p. 164)

Cannot Print, or Printing Malfunctions

Symptom	Cause or Item to check	Remedy and reference
Nothing prints on the paper.	Is the paper reversed (back to front)?	Verify that the recording paper is loaded correctly. "2.4 Load Instrument With Recording Paper (When Model U8350 Printer Unit is installed)" (p. 49)
Printout is too light.	• Is the specified recording paper being used? • Is the print density setting correct? • Is the print head dirty?	Try changing the print density setting. "6.4 Setting the Print Density of the Waveform" (p. 120) Clean the print head. "Print Head Cleaning (When Model U8350 Printer Unit is installed)" (p. 410)
Recording traces are too wide.	The input signal may have a ripple component.	Enable the filter in the module settings. "3.4.2 Choose Analog Channel Settings" (p. 69)
Recording traces are doubled.	Is the waveform printing density set to **[Light]**? In this case, printed dots are spaced out in the vertical direction. Therefore, a slightly varying waveform prints sometimes as one line, and sometimes as two.	Change to waveform printing density setting to something other than **[Light]**. (**[Printer]** sheet) "6.4 Setting the Print Density of the Waveform" (p. 120)

If Saving is Not Possible

Symptom	Cause or Item to check	Remedy and reference
If saving is not possible to the storage media.	• Is your CF card Hioki certified? • Is the storage media inserted properly? • Is the storage media formatted? • Is the remaining capacity of the storage media too low? • Has the number of files in the folder reached the limit?	"2.3 Prepare Storage Media" (p. 46) "To Change Media" (p. 84)
Cannot use USB memory stick	Have the USB memory stick settings been configured?	"USB use" (p. 47)

Other

Symptom	Cause or Item to check	Remedy and reference
Cannot use USB communications	Have the USB communication settings been configured?	"16.6.1 USB Settings on the Instrument" (p. 336)
Cannot install USB driver	Is **[Interface]** set to **[USB]**?	Set **[Interface]** to **[USB]**. "16.6.1 USB Settings on the Instrument" (p. 336)
	Has driver installation failed?	Access **[device manager]** on the PC and delete **[Other Devices]**. Then reconnect the USB cable.
The response of remote control is very slow.	Check the java settings.	For more about java settings, see the application disc supplied with the instrument. This remote operation through a browser is mainly intended for monitoring the screen. If you want more nimble operation, use Model 9333 LAN Communicator.
In remote control operation, the keys are displayed but the screen is not displayed.	Delete Java cache files.	Configure the Java setting from the Control Panel of the PC. For more information, start the application disc supplied with the instrument and open the page of Java (Installing JRE), which describes how to delete cache files.

If the Cause is Unknown

Try performing a system reset. All settings will be returned to their factory defaults.
Refer to "19.2 Reset the Instrument" (p. 402).

19.2 Reset the Instrument

19.2.1 Reset System Settings

Select groups of active settings on the instrument and reset them to their factory defaults. Initialization returns the instrument to its factory default state. By default, the setting of (Status, Ch, Trigger) and [(Environment)] are selected for initialization in this screen.

> The program or arbitrary waveform data of Model U8793 Arbitrary Waveform Generator Unit is written in ROM of module. So it will not get erased even is main instrument is reset.

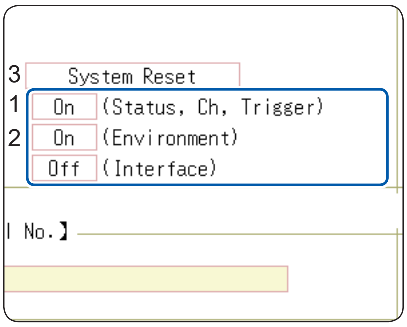
Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[init]** sheet.

1 **Move the cursor to the item you want to reset.**

2 **Select [On].**

Select [Off] for the groups of settings that you do not want to reset.



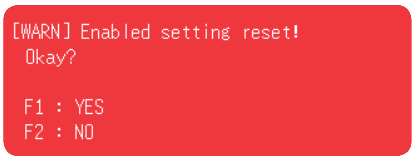
3 System Reset
1 On (Status, Ch, Trigger)
2 On (Environment)
Off (Interface)

(Status, Ch, Trigger)	Current settings on the Status screen, Channel screen, and Trigger setting window (Default setting: On)
(Environment)	Current settings on the **[Environment]** sheet, **[File Save]** sheet, and **[Printer]** sheet (Default setting: On)
(Interface)	Current settings on the **[Interface]** sheet (Default setting: Off)

3 **Move the cursor to [System Reset].**

4 **Select [Exec].**

A confirmation dialog box will appear.



[WARN] Enabled setting reset!
Okay?

F1 : YES
F2 : NO

5 **Select [YES].**

To cancel resetting, select [NO].

Resetting is complete when “System initialized” is displayed.

19.2.2 Reset Waveform Data

Discard the waveform data saved in memory and reset the data.

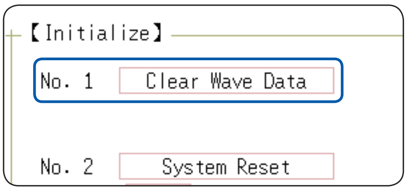
Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[init]** sheet.

1 **Move the cursor to [Clear Wave Data].**

2 **Select [Exec].**

Resetting is complete when “Waveform data erased.” is displayed.

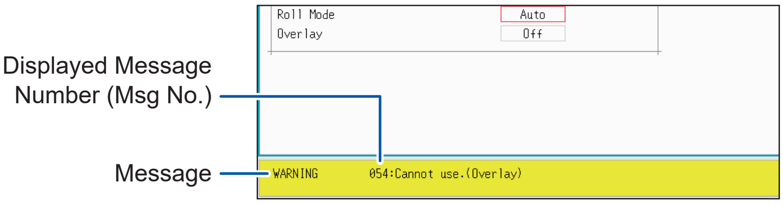


【Initialize】
No. 1 Clear Wave Data
No. 2 System Reset

19.3 Error Messages

If an error is displayed on screen when power supply is switched ON, it is necessary to repair. Contact your authorized Hioki distributor or reseller.
A beep may sound if the beeper setting on the **[Environment]** sheet is **[Warn]** or **[Warn+Action]**.
Refer to “15 System Environment Settings” (p. 313).

Warning Display



WARNING 054:Cannot use.(Overlay)

Appears just once when an error occurs. Disappears within a few seconds.
Also disappears when any key is pressed.

Displayed Warnings

Msg No.	Message	Remedy	References
3	Out of paper.	Load more paper.	“2.4 Load Instrument With Recording Paper (When Model U8350 Printer Unit is installed)” (p. 49)
4	Printer lever is open.	Close the printer lever.	
5	Recording length is set to Continuous.	When the Recording Length (Shot) is set to Continuous (**[Cont.]** **[On]**), real-time printing is not available with fast timebase settings.	“3.3.3 Recording Length (Number of Divisions)” (p. 63)
6	Cannot set. (Time/Div 10ms to 200ms).	When the Recording Length (Shot) is set to Continuous (**[Cont.]** **[On]**), the printer cannot be used.	
10	Mount media.	Set the recording media.	“2.3 Prepare Storage Media” (p. 46)
11	Illegal format.	Wrong recording format. Reformat the media.	“2.3.2 To Format Storage Media” (p. 48)
12	Cannot write.	Write-protection is enabled on the storage media. Disable it.	—
13	Disk full while accessing the file.	Saving is not possible because of insufficient space on the storage media. Delete files or replace the storage media. If measuring, stop measurement then replace the storage media.	“5.5.4 Delete Files and Folders” (p. 107)
14	File is read only.	File is read only. Deletion is not permitted.	—
15	Access to the file was denied.	An internal fault may have occurred in the instrument. Turn the instrument off and back on	—
16	The file name already exists: cannot save.	Change the file name.	“5.5.6 Rename Files and Folders” (p. 109)
17	The folder name already exists.	Change the folder name.	

Msg No.	Message	Remedy	References
18	Not enough free space in the folder to create file.	Either delete files in the saving destination folder, or change to another saving destination.	—
19	Folder not empty.	The folder is not empty, be sure you want to delete.	—
20	The maximum length of a file name, including its path, is 255 characters.	File names including the path must not exceed 255 characters.	—
21	Internal error.	An internal error occurred. Check the storage media.	—
22	No waveform data to save.	Acquire waveform data.	—
24	There is no calculation result.	There is no calculation result. Print results after performing calculation.	“10 Numerical Calculation Functions” (p. 217)
25	Cannot select this media.	You cannot select this medium as a destination of auto-saving. Select another medium.	—
26	Invalid folder path.	Route cannot be specified.	—
27	When executing, select “No” as the save property.	As other dialogs are displayed, selective saving cannot be carried out. Either set selective saving during execution to **[No]** or close the dialog and re-save.	“5.2.3 Save Data Selectively (SAVE Key)” (p. 94)
28	Pressed key invalid (waveform evaluation).	Unable to perform operation because waveform evaluation is enabled. Turn **[Off]** waveform evaluation.	“14.3 Set the Waveform Evaluation Mode” (p. 304)
29	The recording length was restricted.	—	—
30	Auto-ranging failed.	Check the input signal.	“3.6 Measurement With Automatic Range Setting (Auto-ranging Function)” (p. 76)
31	AB cursor positions invalid.	The AB cursors overlap. Check the cursor positions.	“7.2 Specify a Waveform Range (AB Cursor)” (p. 131)
32	Zero-adjustment needed.	Perform zero-adjustment.	“2.7 Adjust the Zero Position (Zero-Adjust)” (p. 53)
33	Disabled key.	Close the dialog.	—
34	Invalid key pressed (Overlay)	The key operation is prohibited because Overlay is enabled. Set Overlay to **[Off]**.	“8.3 Display New Waveforms Over Past Waveforms (Overlay)” (p. 154)
36	No trigger has been set.	Set trigger criteria.	“9 Trigger Settings” (p. 195)
38	Use of logic channels has reduced analog waveform resolution from 16 to 12 bits.	Using channels LA - LD reduces the resolution of CH1 to CH4 to 12 bits. Using channels LE - LH reduces the resolution of CH17 to CH20 to 12 bits.	“8.10 Detailed Settings for Modules” (p. 170)
39	Auto-balance failed.	Check if no load is applied to the strain gauge transducer and the strain gauge transducer is correctly connected to a measuring object.	“8.10.4 Setting Model 8969 and U8969 Strain Unit” (p. 174)

Msg No.	Message	Remedy	References
40	Voltage Sag triggering is disabled. (Valid time base range: 20 μs/div to 50 ms/div)	Voltage Sag triggering can be used only when the time base is between 20 μs/div to 50 ms/div	“9.3 Analog Signal Triggers” (p. 198)
41	Channels that are not measurable will be assigned to X-Y.	Channel with specification exceeding **[Used Ch]** is selected. Change channel selection.	“8.4 Setting Channels to Use (Extending the Recording Length)” (p. 156)
42	There is not enough data in the memory.	Measure the correct amount data required for calculation.	“11.1 Waveform Calculation Workflow” (p. 234)
43	Stopped.	—	—
44	Current clamp/sensor was recognized.	—	—
45	Current clamp/sensor was disconnected.	Check the connection of the current clamp/sensor.	—
46	Channels may no longer be able to be used by frequency units due to logic channel use.	If LA to LE or LD to LH are used, the frequency units cannot be used at channels CH1 to CH4 or CH17 to CH20 respectively.	“3.4.3 Logic Channel Settings” (p. 72)
47	This module cannot be used because it is not AAF aligned.	Press the **SYSTEM** key to display the **[Init]** sheet. Execute **[System Information]** and check the software items. If **[Not AAF aligned]** is displayed, send the module for repairs.	—
48	There are module on which AAF cannot be set to On because of lack of adjustment.		
50	Roll Mode is not available.	Roll Mode cannot be used when Overlay is enabled.	“8.2 Display Waveforms During Recording (Roll Mode)” (p. 153)
51	Cannot use. (Pre Trigger)	The pre-trigger function is not available when using external sampling.	“17 External Control” (p. 343)
52	Cannot use. (Roll Mode, Memory Division)	If the waveform calculation function is in use, these functions cannot be used.	“11.1 Waveform Calculation Workflow” (p. 234)
53	Cannot use. (Roll Mode, Memory Division, Wave Calculation)	If one function is in use, the other functions cannot be used.	“8.2 Display Waveforms During Recording (Roll Mode)” (p. 153)
54	Cannot use.(Overlay)	The overlay function is not available when using the Roll mode.	“8.3 Display New Waveforms Over Past Waveforms (Overlay)” (p. 154)
55	Cannot use. (Overlay, Memory Division, Wave Calculation)	If roll mode is in use, these functions cannot be used.	“8.2 Display Waveforms During Recording (Roll Mode)” (p. 153)
56	Real-time printing is not available.	Recording Length (Shot) is set to Continuous (**[Cont.]** **[On]**). Real-time printing is not available when using the Recorder function and a fast timebase setting.	“3.3.3 Recording Length (Number of Divisions)” (p. 63) “6.2 Auto-print Settings” (p. 115)

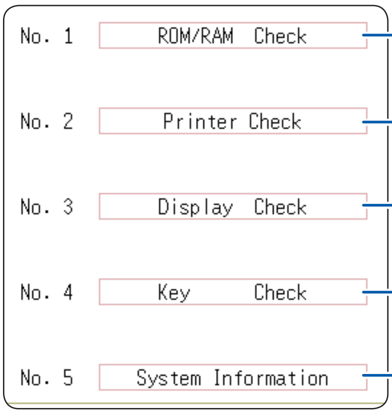
Msg No.	Message	Remedy	References
57	Cannot set.(External sampling)	Cannot use roll mode when using external sampling.	“8.2 Display Waveforms During Recording (Roll Mode)” (p. 153)
58	Rated capacity/rated output error.	Rated capacity/Rated output has exceeded selected range. Input correct value.	(p. 160)
59	Cannot use. (Roll Mode, Wave Calculation)	If the memory division function is in use, these functions cannot be used.	“12.1 Recording Settings” (p. 247)
60	No waveform data.	Acquire waveform data.	—
68	Recording length is too long.	Shorten the measurement recording length. The maximum recording length that can be calculated is 40,000 div.	“3.3.3 Recording Length (Number of Divisions)” (p. 63)
80	In key lock.	Keylock is engaged. Cancel the Key-Lock function.	“KEY LOCK” (p. 19)
91	LAN: Bad IP address.	Check the IP address.	“16.1 LAN Connection and Settings (Before Using FTP/ Internet Browser/Command Communications)” (p. 318)
95	LAN: Connection timed out.	Check the transmission settings.	
97	LAN: Network error.	Check the connection between the instrument and connection destination.	
100	Inappropriate setting of time axis for waveform data.	Return the timebase to the timebase setting when the waveform was measured.	“3.3.2 Timebase and Sampling Rate” (p. 60) “9.11 Use Trigger Settings to Search Measurement Data” (p. 215)
101	Some blocks are different in time axis setting from the others.	Set the same timebase setting for all search target blocks. If they cannot be the same, set the search range to display blocks only.	
102	Some blocks are different in modules configuration from the others.	Unify the modules configuration of search target blocks. If they cannot be the same, set the search range to display blocks only.	“9.11 Use Trigger Settings to Search Measurement Data” (p. 215)
103	No data matching your search condition.	Check the trigger setting.	
104	There is no data in the search target channel.	Select channels with measurement data in the search target.	
105	There is a block with no data in the search target channel.	Select blocks with measurement data in the search target.	
106	Some blocks are different in measurement mode of modules from the others.	Blocks with varying measurement modes cannot be searched.	—
108	Some blocks are different in measurement mode of modules from the others.	Set the search range within the display blocks.	“9.11 Use Trigger Settings to Search Measurement Data” (p. 215)
110	No space to store waveform data at copy location.	Create empty space by deleting waveform data from copy location.	(p. 191)
111	No space to register arbitrary waveform data.	Create empty space by deleting waveform data from registration location.	(p. 191)

19.4 Self-Test (Self Diagnostics)

The following self-test checks are available.

Procedure

Press the **SYSTEM** key to open the System screen, and then select the **[init]** sheet.



Check the instrument's internal memory (ROM and RAM). The results will be displayed on the screen. (p. 407)

Check printing and clean print heads. (p. 408), (p. 410)

Check the screen display (color check, gradation check). (p. 408)

Check whether instrument keys are functioning correctly. (p. 409)

Check the system configuration. (p. 409)

19.4.1 ROM/RAM Check

This check tests the instrument's internal memory (ROM and RAM).

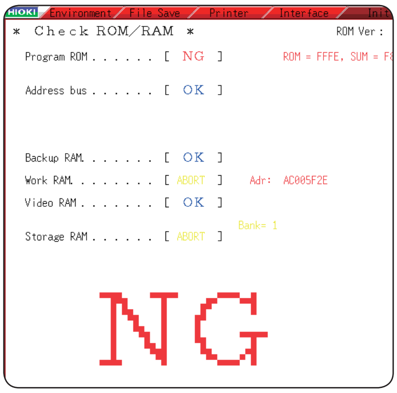
Performing a ROM/RAM check will erase measurement data.
Save measurement data to other media before performing the ROM/RAM check.

1. **Move the cursor to [ROM/RAM Check].**
2. **Select [Exec].**

The ROM/RAM check will start.

The following checks are performed in the sequence shown.
Program ROM → Address bus → Backup RAM → Work RAM → Video RAM → Storage RAM

Do not turn the power off during the check.



```
*  Check ROM/RAM  *                                   ROM Ver :
  Program ROM . . . . . .  [  NG  ]        ROM = FFFE, SUM = F

  Address bus . . . . . .  [  OK  ]


  Backup RAM. . . . . . .  [  OK  ]
  Work RAM. . . . . . . .  [ ABORT ]   Adr:  AC005F2E
  Video RAM . . . . . . .  [  OK  ]
                                     Bank= 1
  Storage RAM . . . . . .  [ ABORT ]

              NG
```

To cancel the check, press the STOP key.

The current check will be interrupted and the next one will start.
All operation keys (except **STOP** key) are disabled during execution of the check.

The judgment results appear when the checks finish.
OK: Normal
NG: Error
ABORT: When a check is interrupted

If “NG” appears, ask to have the instrument repaired.

Press any key to return to the original screen.

Procedure (Common to Printer Check, Display Check, Key Check, System Configuration Check)

Press the **SYSTEM** key to open the System screen, and then select the **[init]** sheet.

19.4.2 Printer Check (When Model U8350 Printer Unit is Installed)

This check tests the condition of the printer.
Before executing, check to be sure that recording paper is loaded.

1. **Move the cursor to [Printer Check].**
2. **Select [Exec].**

   A test pattern will be printed.
   About 5 cm of each of the following patterns will be printed, in order: Checkerboard → Vertical lines → Slanted lines → Characters

   To cancel the check, press the STOP key.

Things to check after the printer check
Check the printed recording paper for white streaks.
If there are any white streaks, clean the print heads (p. 410)

Print quality (print speed) and print density settings will be reflected in the test printout.

19.4.3 Display Check

This check tests the condition of the display screen.

1. **Move the cursor to [Display Check].**
2. **Select [Exec].**

   A red screen will appear.

3. **Press any key to check the display condition.**

   The screen changes each time you press an operation key.

   You will be returned to previous screen.

Screen Changes
Color check (Red, Green, Blue, Black, White) → Gradation check (Red, Green, Blue, Black, White) → Color pattern → Original screen.

If the display screen seems abnormal, request repairs.

19.4.4 Key Check

This check tests operation of the keys and jog/shuttle controls.

1 **Move the cursor to [Key Check].**

2 **Select [Exec].**

Operation keys will be displayed.

3 **Press each operation key once or more.**

The corresponding key will be highlighted over.

Jog: Rotate to the left and right, one time or more in each direction.

Shuttle: Turn slowly all the way in each direction.

(The **START** key also functions as an LED light check key.)

The check is finished when you have operated all the keys.

To cancel the check, press the START and STOP keys simultaneously

You will be returned to previous screen.

The key check will not finish if there is a problem that prevents even one of the keys from being recognized. If this occurs, press the **STOP** and **START** keys simultaneously to display the previous screen.
There may be a malfunction in the instrument, please request repairs.

If there is a problem with the **STOP** or **START** key, you cannot return to the previous screen. Power the instrument off and request repairs.

19.4.5 System Configuration Check

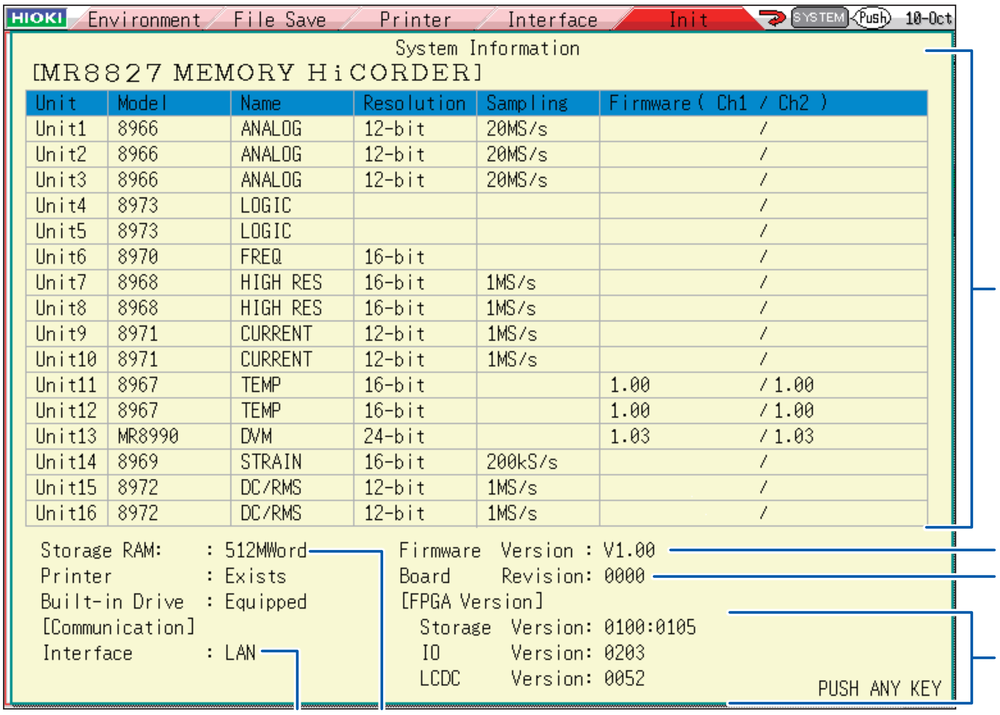
The list of installed options and other system information will be displayed in a separate window.

1 **Move the cursor to [System Information].**

2 **Select [Exec].**

The **[System Configuration]** List will be displayed.

To return to the previous screen, press any key.



System Information

[MR8827 MEMORY HiCORDER]

Unit	Model	Name	Resolution	Sampling	Firmware (Ch1 / Ch2)
Unit1	8966	ANALOG	12-bit	20MS/s	/
Unit2	8966	ANALOG	12-bit	20MS/s	/
Unit3	8966	ANALOG	12-bit	20MS/s	/
Unit4	8973	LOGIC			/
Unit5	8973	LOGIC			/
Unit6	8970	FREQ	16-bit		/
Unit7	8968	HIGH RES	16-bit	1MS/s	/
Unit8	8968	HIGH RES	16-bit	1MS/s	/
Unit9	8971	CURRENT	12-bit	1MS/s	/
Unit10	8971	CURRENT	12-bit	1MS/s	/
Unit11	8967	TEMP	16-bit		1.00 / 1.00
Unit12	8967	TEMP	16-bit		1.00 / 1.00
Unit13	MR8990	DVM	24-bit		1.03 / 1.03
Unit14	8969	STRAIN	16-bit	200kS/s	/
Unit15	8972	DC/RMS	12-bit	1MS/s	/
Unit16	8972	DC/RMS	12-bit	1MS/s	/

```
Storage RAM:     : 512MWord        Firmware  Version : V1.00
Printer          : Exists          Board     Revision: 0000
Built-in Drive   : Equipped        [FPGA Version]
[Communication]                      Storage  Version: 0100:0105
Interface        : LAN               IO       Version: 0203
                                     LCDC     Version: 0052
                                                          PUSH ANY KEY
```

Model number, name, resolution, sampling rate and firmware version no. of each installed module (unit)

Firmware version no.

Board revision no.

FPGA version no.

Currently selected interface

Internal memory capacity

19.5 Cleaning

Print Head Cleaning (When Model U8350 Printer Unit is installed)

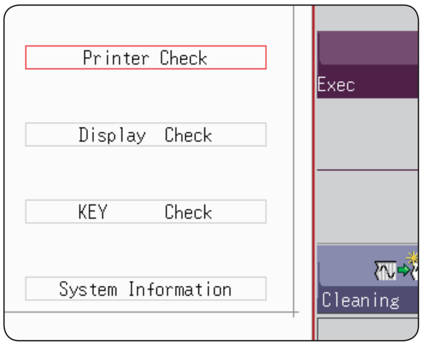
⚠WARNING

The print head and surrounding metal parts can become hot. Perform cleaning only after making sure that the parts have cooled fully. Be careful to avoid touching these parts.

Normally, no maintenance is required. However, depending on usage conditions, dirt and paper dust may accumulate on the thermal head over long periods, which can cause light or smeared printing. In this case, clean the head by following the procedure below.

To Clean the Print Head

Before Cleaning
Recording paper is required to clean the print head. Verify that the recording paper is loaded correctly.



1. **Press the SYSTEM key to display the [Init] sheet.**
2. **Move the cursor to [Printer Check].**
3. **Select [Exec].**

   If printing is blurred, wash the printer head.

   By selecting [Cleaning], paper dust can be cleared readily. If sufficient improvement is not obtained even after cleaning several times, wash the print head.

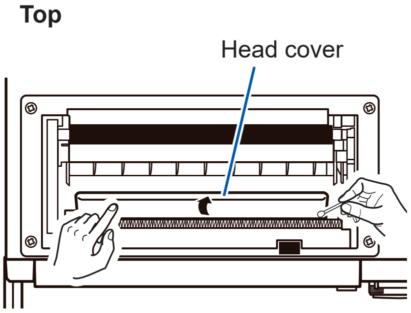
To Wash the Print Head

Required item: Undiluted alcohol, Cotton swab

1. **Moisten the end of a cotton swab with undiluted alcohol.**

   Be careful not to apply too much undiluted alcohol.

2. **Open the head cover and wipe the print head with the tip of the cotton swab.**



About the Print Head

Note the following precautions to avoid discoloration or deformation.

- Do not use organic solvents such as thinner or benzene.
- After washing, be certain that the printer is completely dry before use.

About the Roller Surface

- White powder such as paper dust may accumulate on the roller surface after long-term use. A small amount should have no effect on printing, but can be removed with a commonly available camera blower brush if it causes concern.
- Always use the paper cutter to cut the printed paper. Excessive paper dust can accumulate on the roller if the paper is cut by the print head.

To Clean the Instrument and Modules

⚠CAUTION

Clean the vents periodically to avoid blockage.
If the vents become clogged the instrument's internal cooling will be impeded, which may result in damage.

- To clean the instrument and modules wipe it gently with a soft cloth moistened with water or mild detergent.
- Wipe the LCD gently with a soft, dry cloth.

19.6 Dispose of the Instrument (Lithium Battery Removal)

The instrument contains a lithium battery for memory backup. Remove this battery before disposing of the instrument.

⚠WARNING

- **To avoid electric shock, turn off the power and disconnect the power cord and connection cables before removing the lithium battery.**
- **Keep batteries away from children to prevent accidental swallowing.**

- **The battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.**

When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

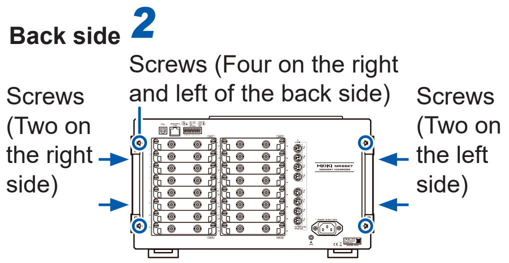
CALIFORNIA, USA ONLY
Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Removing the Lithium Battery

Required items: Philips screwdriver, wire cutter, hex wrench (One each)

1 **Ensure that the power is off, and remove the connection cables and power cord.**

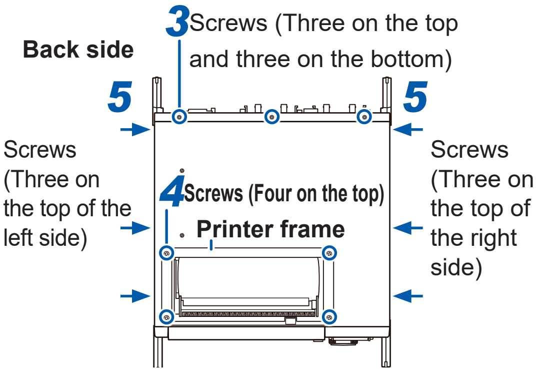
2 **Remove the handle by removing the screws securing it (four on the right and left of the back side, two on the right side, two on the left side).**


Back side
2
Screws (Four on the right and left of the back side)
Screws (Two on the right side)
Screws (Two on the left side)

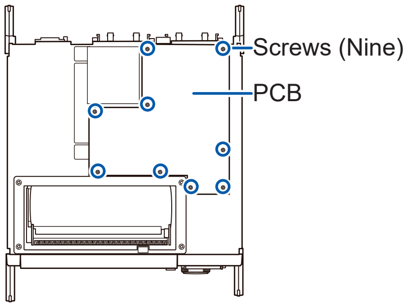
3 **Remove the back side cover by removing three screws on the top and bottom respectively.**

4 **Remove the printer frame by removing the screws securing it (four on the top).**

5 **Remove the top cover by removing three screws on the top of the right side and the top of the left side respectively.**


Back side
3
Screws (Three on the top and three on the bottom)
5
5
Screws (Three on the top of the left side)
4
Screws (Four on the top)
Printer frame
Screws (Three on the top of the right side)

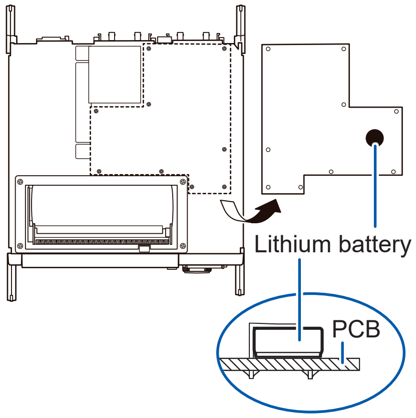
6 **Remove the nine screws securing the circuit board.**



7 **Flip the circuit board.**

8 **Pull the lithium battery up from the circuit board, and cut the two leads at the positive and negative electrodes with a wire cutter.**

9 **Remove the battery from the board.**



Appendix

Appx. 1 Default Values for Major Settings

Screen	Sheet/ Window	Items	Settings
Status	Status	Timebase (Memory)	5 μs/div
		Timebase (Recorder)	10 ms/div
		Sampling (X-Y Recorder)	100 ms/S
		Shot	25 div
		Format (Memory / Recorder)	Single
		Format (X-Y Recorder)	X-Y Single
		Roll Mode (Memory)	Auto
		Used Ch (Memory)	32 channels
		Dots-Line (X-Y Recorder)	Line
	Num Calc.	Numerical Calc	Off
System	Environment	Grid	Dotted Line
		Time Val	Time
		Beep Sound	Warn
		Auto Scal	On
	File Save	Auto Save	Off
	Printer	Auto Print	Off
		Grid	Standard
		Ch Mark	Ch No.
		Time Val	Time
		Mag/Comp	Same to display
		Copy GUI	Yes
		Print Area	All Wave
	Interface	Interface	LAN
		USB Set	USB Memory
Channel	Unit List	Wave_Disp (analog)	Color 1 - 16
		Wave Density	Standard
		Wave_Disp (Logic)	Off
		Logic Width	Normal
		Range	Maximum sensitivity
		Coupling	DC
	Scaling	Disp	Ratio
		Each channel	Off
	Comment	Print Comment (Title)	Setting
		Print Comment (Analog)	Setting
		Print Comment (Logic)	Off
Waveform	Trigger settings window	Trigger Mode (Memory)	Auto
		Trigger Mode (Recorder)	Single
		PreTrigger (Memory)	0%
		Trigger Source	OR
		Timing	Start
		Trigger for each module	Off
		Timer Trigger	Off
		External Trigger	Off

Appx. 2 For Reference

Appendix 2.1 Waveform File Sizes

References

File Type	Function	Size	Calculation method
MEM File	Memory Function	(p. A2)	(p. A4)
REC File	Recorder Function	(p. A2)	(p. A4)
FFT File	FFT Function	(p. A3)	(p. A4)
XYC File	X-Y Recorder Function	(p. A3)	(p. A4)
CSV (Text) File	Memory Function	(p. A3)	(p. A4)
	Recorder Function	(p. A4)	(p. A4)

References of the File Size

MEM File Size (Memory Function)

File size = setting size + data size
Calculation method: “MEM File” (p. A4)

Recording length (div)	Data quantity	Saved channels					
		1	2	4	8	16	32
100	10,001	48 KB	68 KB	108 KB	188 KB	349 KB	669 KB
1,000	100,001	224 KB	420 KB	811 KB	1.6 MB	3.1 MB	6.1 MB
10,000	1,000,001	1.9 MB	3.8 MB	7.7 MB	15 MB	31 MB	61 MB
100,000	10,000,001	19 MB	38 MB	76 MB	153 MB	305 MB	610 MB
1,000,000	100,000,001	191 MB	381 MB	763 MB	-	-	-

REC File Size (Recorder Function)

Filesize = setting size + data size
Calculation method: “REC File” (p. A4)

Recording length (div)	Data quantity	Saved channels					
		1	2	4	8	16	32
100	10,001	68 KB	107 KB	186 KB	345 KB	661 KB	1.3 MB
1,000	100,001	419 KB	810 KB	1.6 MB	3.1 MB	6.1 MB	12 MB
10,000	1,000,001	3.8 MB	7.7 MB	15 MB	31 MB	61 MB	122 MB
20,000	2,000,001	7.7 MB	15 MB	31 MB	61 MB	122 MB	244 MB
50,000	5,000,001	19 MB	38 MB	76 MB	153 MB	305 MB	610 MB

FFT File Size (FFT Function)

File size = header size + size of time axis data + size of mid-term data
Calculation method: “FFT File” (p. A4)

Data quantity	Number of calculations	
	1	2
1,000	388 KB	729 KB
2,000	728 KB	1.4 MB
5,000	1.7 MB	3.4 MB
10,000	3.4 MB	6.7 MB

XYC File Size (X-Y Recorder Function)

File size = setting size + data size
Calculation method: “XYC File” (p. A4)

Data quantity	Saved channels				
	1	2	4	8	16
10,000	49 KB	69 KB	109 KB	189 KB	350 KB
100,000	225 KB	421 KB	812 KB	1.6 MB	3.1 MB
1,000,000	1.9 MB	3.8 MB	7.7 MB	15 MB	31 MB
2,000,000	3.8 MB	7.7 MB	15 MB	31 MB	61 MB
16,000,000	31 MB	61 MB	122 MB	244 MB	488 MB

CSV (Text) File Size (Memory Function)

File size = header size + data size
Calculation method: “CSV (Text) File” (p. A4)

Recording length (div)	Data quantity	Saved channels					
		1	2	4	8	16	32
100	10,001	313 KB	450 KB	723 KB	1.2 MB	2.3 MB	4.4 MB
1,000	100,001	3.1 MB	4.4 MB	7.1 MB	12 MB	23 MB	44 MB
10,000	1,000,001	31 MB	44 MB	71 MB	124 MB	231 MB	444 MB
100,000	10,000,001	305 MB	439 MB	706 MB	1.2 GB	2.3 GB	4.3 GB
1,000,000	100,000,001	3.0 GB	4.3 GB	6.9 GB	-	-	-

CSV (Text) File Size (Recorder Function)

File size = header size + data size
Calculation method: “Recorder Function” (p. A4)

When saving, CSV (text) files longer than 2 GB are segmented into files of 2 GB each.

Recording length (div)	Data quantity	Saved channels					
		1	2	4	8	16	32
100	10,001	450 KB	723 KB	1.2 MB	2.3 MB	4.4 MB	8.7 MB
1,000	100,001	4.4 MB	7.1 MB	12 MB	23 MB	44 MB	87 MB
10,000	1,000,001	44 MB	71 MB	124 MB	231 MB	444 MB	872 MB
50,000	5,000,001	219 MB	353 MB	620 MB	1.1 GB	2.2 GB	4.3 GB

Waveform File Size Calculation Method

MEM File

File size (bytes) = setting size[*1] + data size[*2]

*1: (Setting size) =28672 + 512 × [(number of analog channels) + 4 × (number of logic units) + (number of waveform calculation channels)]

*2: (Data size) = 2 × [(number of analog channels) + (number of logic units) + 2 × (number of waveform calculation channels)] × (number of data)

REC File

File size (bytes) = setting size[*1] + data size[*2]

*1: (Setting size) = 28672 + 512 × [(number of analog channels + 4 × (number of logic units)]

*2: (Data size) = 4 × [(number of analog channels) + (number of logic units)] × (number of data)

FFT File

File size (bytes) =header size[*1] + size of time axis data[*2] + size of mid-term data[*3]

*1: (Header size) = 30720 + 512 × [(number of analog channels) + (number of waveform calculation channels) + (number of FFT calculation channels) + 1]

*2: (Size of time axis data) = [(number of analog channels) + 2 × (number of waveform calculation channels)] × (number of data) (*4)

*3: (Size of mid-term data) = [346 × (number of FFT points) + 836] × (number of FFT calculation channels) (*4)

(Depending on the measurement conditions, the file size may also increase or decrease from calculation formula results)

XYC File

File size (bytes) = header size[*1] + data size[*2]

*1: (Header size) = 24576 + 512 × (number of analog channels)

*2: (Data size) = 2 × (number of saved analog channels) × (number of data)

CSV (Text) File

Memory Function

File size (bytes) = header size[*1] + data size[*2]

*1: (Header size) = 194 + 103 × [(number of saved analog channels) + number of saved logic channels)]

*2: (Data size) = [18 + 14 × (number of saved analog channels) + 2 × (number of logic channels)] × (number of data)

Recorder Function

File size (bytes) = header size[*1] + data size[*2]

*1: (Header size) = 194 + 130 × [(number of saved analog channels) + (number of saved logic channels)]

*2: (Data size) = [18 + 28 × (number of saved analog channels) + 4 × (number of logic channels)] × (number of data)

Appendix 2.2 Configuration and Image Data File Size Settings

File	Size
Setting file	33 KB
BMP (No color compression)	470 KB
BMP (Gray scale/No compression)	470 KB
BMP (B/W/No compression)	59 KB
BMP (B/W Reverse/No compression)	59 KB

Appendix 2.3 Timebase and Maximum Recordable Time

The maximum available recording time of the Memory function depends on the selected timebase.
The maximum recording time can be obtained by the following formula.

Recordable Time
= Timebase × Recording Length

Recordable time can be verified on the Status screen - **[Status]** sheet. (**[Recording period]**)

- Setting a slow timebase may result in a very long recording time (over a year) which may exceed the guarantee period or product life, in which case we cannot guarantee operation.
- The maximum recording length also depends on the number of channels used.
- When using the X-Y Recorder function, the maximum number of samples is 16,000,000.

Recorder Function

Timebase/div	Maximum recording length: 80,000 div
10 ms	13 min 20 s
20 ms	26 min 40 s
50 ms	1 h 6 min 40 s
100 ms	2 h 13 min 20 s
200 ms	4 h 26 min 40 s
500 ms	11 h 6 min 40 s
1 s	22 h 13 min 20 s
2 s	1 d 20 h 26 min 40 s
5 s	4 d 15 h 6 min 40 s
10 s	9 d 6 h 13 min 20 s
30 s	27 d 18 h 40 min 0 s
50 s	46 d 7 h 6 min 40 s
1 min	55 d 13 h 20 min 0 s
100 s	92 d 14 h 13 min 20 s
2 min	111 d 2 h 40 min 0 s
5 min	277 d 18 h 40 min 0 s
10 min	
30 min	
1 h	

(d: days/h: hours/min: minutes/s: seconds)

* When recording length is set to **[Cont.]**, the maximum recording length is 80,000 div.

Memory Function

Timebase/div	Sampling rate	Maximum recording length
		32 channels
		160,000 div
5 µs	50 ns	0.8 s
10 µs	100 ns	1.6 s
20 µs	200 ns	3.2 s
50 µs	500 ns	8 s
100 µs	1 µs	16 s
200 µs	2 µs	32 s
500 µs	5 µs	1 min 20 s
1 ms	10 µs	2 min 40 s
2 ms	20 µs	5 min 20 s
5 ms	50 µs	13 min 20 s
10 ms	100 µs	26 min 40 s
20 ms	200 µs	53 min 20 s
50 ms	500 µs	2 h 13 min 20 s
100 ms	1 ms	4 h 26 min 40 s
200 ms	2 ms	8 h 53 min 20 s
500 ms	5 ms	22 h 13 min 20 s
1 s	10 ms	1 d 20 h 26 min 40 s
2 s	20 ms	3 d 16 h 53 min 20 s
5 s	50 ms	9 d 6 h 13 min 20 s
10 s	100 ms	18 d 12 h 26 min 40 s
30 s	300 ms	55 d 13 h 20 min 0 s
50 s	500 ms	92 d 14 h 13 min 20 s
1 min	600 ms	111 d 2 h 40 min 0 s
100 s	1 s	185 d 4 h 26 min 40 s
2 min	1.2 s	222 d 5 h 20 min 0 s
5 min	3 s	

(d: days/h: hours/min: minutes/s: seconds)

Appendix 2.4 Maximum recording length and number of divisions (Memory division function)

The maximum recording length is automatically determined when you set the number of divisions.

Desired Recording length

The number of divisions (blocks)	Maximum recording length (div)
2	80,000
4	40,000
8	20,000
16	10,000
32	5,000
64	2,500
128	1,200
256	600
512	300
1024	150

Fixed Recording length

The number of divisions (blocks)	Maximum recording length (div)
2	50,000
4	20,000
8	20,000
16	10,000
32	5,000
64	2,000
128	1,000
256	500
512	200
1024	100

Appendix 2.5 Scaling Method for Strain Gauges

This section describes how to determine the scaling conversion ratio when performing measurement with strain gauges and the 8969 and U8969 Strain Unit.

The appropriate conversion formula for stress depends on how the strain gauges are used.
Three methods are available depending on whether one, two or four strain gauges are used for measurement. The two-gauge method is used for temperature compensation.

E: Young's modulus, ν: Poisson's ratio, ε: Distortion measurement value

Tensile and Compressive Stress Measurement: Stress (σ) = E × ε
For temperature compensation with two or four gauges, position the gauges perpendicularly.
Stress (σ) is obtained by $1 / (1 + \nu)$ for two gauges, and by $1 / \{2 (1 + \nu)\}$ for four gauges.

Bending Stress Measurement: Stress (σ) = E × ε
For temperature compensation with two or four gauges, stress (σ) is obtained as a multiple of ½ or ¼, respectively.

Torsional Stress Measurement: Stress (σ) = $E / \{2 (1 + \nu)\} \times \varepsilon$ (with two gauges)
When using four gauges, that the values are halved.

Refer to the strain gauge instruction manual for combinations of strain gauges for each measurement.

Example. Measuring Compressive Stress
Using the one-gauge method for an aluminum measurement object with a Young's modulus of 73 (GPa) according to the following calculation:
$\sigma = 73 \times 10^9 \times$ Measurement Value (in $\mu\varepsilon$ units) $\times 10^{-6}$ (in $\mu\varepsilon$ units)
= 73 × Measurement Value (in kPa units)
= 7.44* × Measurement Value (in gf/mm^2 units)
* 1 Pa = $1.01971621 \times 10^{-7}$ kgf/mm^2 =1N/m^2
Unit: gf/mm^2, Conversion Ratio = 7.44 gf/mm^2
Enter this value as the scaling conversion ratio

Mechanical properties of industrial materials

Material	Modulus of Elasticity (Young's Modulus)	Poisson's Ratio
	E (GPa)	ν
Carbon steel (0.1 to 0.25% C)	205	0.28 to 0.3
Carbon steel (> 0.25% C)	206	0.28 to 0.3
Spring steel (Quenched)	206 to 211	0.28 to 0.3
Nickel steel	205	0.28 to 0.3
Cast iron	98	0.2 to 0.29
Brass (Cast)	78	0.34
Phosphor bronze	118	0.38
Aluminum	73	0.34
Concrete	20 to 29	0.1

Refer to “8.5 Convert Input Values (Scaling Function)” (p. 157).

Appx. 3 About Options

Appendix 3.1 Options

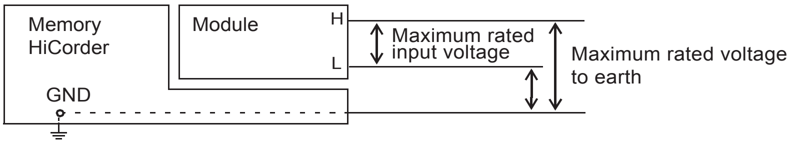
The following options are available for the instrument. Contact your authorized Hioki distributor or reseller when ordering. The options are subject to change. Visit our website for updated information.
For details of cables and clamp sensors for connecting to the modules and the instrument, refer to manual supplied with them. Items indicated “specify when ordering” are not user-installable. For new purchases, contact your Hioki distributor.

Modules (Measurement amplifiers)

These are installed by insertion into the compartments on the right side of the instrument. Modules can be swapped out as needed.

Application	Model	Number of channels	Maximum sampling rate	A/D resolution	Maximum input voltage	Maximum rated voltage to earth
Voltage measurement	Model 8966 Analog Unit	2	20 MS/s	12 bits	400 V DC	300 V AC, DC (CAT II)
	Model 8968 High Resolution Unit	2	1 MS/s	16 bits	400 V DC	300 V AC, DC (CAT II)
	Model MR8990 Digital Voltmeter Unit	2	500 S/s	24 bits	500 V DC	300 V AC, DC (CAT II)
RMS voltage measurement	Model 8972 DC/RMS Unit	2	1 MS/s	12 bits	400 V DC	300 V AC, DC (CAT II)
	Model U8974 High Voltage Unit	2	1 MS/s	16 bits	1000 V DC 700 V AC	1000 V AC, DC (CAT III) 600 V AC, DC (CAT IV)
Temperature (Thermocouple) measurement	Model 8967 Temp Unit	2	-	16 bits	-	300 V AC, DC (CAT II)
Frequency, count, pulse duty, and pulse width measurements	Model 8970 Freq Unit	2	-	16 bits	400 V DC	300 V AC, DC (CAT II)
Current measurement	Model 8971 Current Unit	2	1 MS/s	12 bits	-	Not insulated.
Strain (Strain gauge type converter) measurement	Model 8969 Strain Unit	2	200 kS/s	16 bits	-	33 V rms AC or 70 V DC
	Model U8969 Strain Unit					30 V rms AC or 60 V DC
Digital signals and contact signal measurement	Model 8973 Logic Unit	16	20 MS/s	-	-	Not insulated.
Acceleration measurement (sensor with built-in pre-amplifier, charge-output sensor)	Model U8979 Charge Unit	2	200 kS/s	16 bits	40 V DC	30 V AC, 60 V DC

Refer to “18.6 Module Specifications” (p. 368).



Module (for generation)

These modules can be installed along with a measurement module.

Application	Model	Number of channels	Maximum output frequency	Output voltage
Arbitrary waveform generation	Model U8793 Arbitrary Waveform Generator Unit	2	100 kHz	-10 V to 15 V
Sine wave and DC generation	Model MR8790 Waveform Generator Unit	4	20 kHz	±10 V
Pulse generation	MR8791 Pulse Generator Unit	8	100 kHz	0 V to 5 V

Measurement probes, cords, and clamp sensors

Application	Model	Description	Maximum input voltage	Maximum rated voltage to earth
Voltage measurement	Model L9197 Connection Cable	For high voltage	600 V AC, DC	600 V AC, DC (CAT III) 300 V AC, DC (CAT IV)
	Model L9198 Connection Cable	For low voltage	300 V AC, DC	600 V AC, DC (CAT II) 300 V AC, DC (CAT III)
	Model L9790 Connection Cable		600 V AC, DC	With Model L9790-01 Alligator Clip or Model 9790-03 Contact Pin attached: 600 V AC, DC (CAT II) 300 V AC, DC (CAT III) With Model 9790-02 Grabber Clip attached: 300 V AC, DC (CAT II) 150 V AC, DC (CAT III)
	Model L9217 Connection Cable	Isolated BNC-Isolated BNC	300 V AC, DC	600 V AC, DC (CAT II) 300 V AC, DC (CAT III)
	Model 9322 Differential Probe	For high voltage • Model 9418-15 AC Adapter is required when connecting to the module for voltage measurement.	2000 V DC, 1000 V AC	With grabber clips attached: 1000 V AC, DC (CAT II) With alligator clips attached: 1000 V AC, DC (CAT II) 600 V AC, DC (CAT III)
	Model L4940 Connection Cord	For Model U8974 High Voltage Unit	1000 V DC	With Model L4935 Alligator Clip Set or Model L4932 Test Pin Set attached: 600 V AC/DC (CAT IV) 1000 V AC/DC (CAT III, CAT II)
				With Model L9243 Grabber Clip attached 1000 V AC (CAT II)
				With Model L4936 Bus Bar Clip Set attached: 600 V AC/DC (CAT III)
				With Model L4937 Magnetic Adapter Set attached: 1000 V AC/DC (CAT III)
				With Model L4934 Small Alligator Clip Set attached 300 V AC/DC (CAT III) 600 V AC/DC (CAT II)

Application	Model	Description	Maximum input voltage	Maximum rated voltage to earth
Voltage measurement	Model P9000-01 Differential Probe Model P9000-02 Differential Probe	The Model Z1008 AC Adapter or a commercially available USB cable is required.	1000 V AC, DC	1000 V AC, DC (CAT III)
	Model 9665 10:1 Probe	Maximum rated voltage above ground is that of the module.	1 kV rms (up to 500 kHz)	-
	Model 9666 100:1 Probe	Maximum rated voltage above ground is that of the module.	5 kV peak (up to 1 MHz)	-
	Model 9166 Connection Cord	For inputting voltage to Model U8979	30 V AC, 60 V DC	-
Logic signal input	Model 9320-01 Logic Probe	Four channels, for detecting voltage and closed/open contact points	-	-
	Model MR9321-01 Logic Probe	Four isolated channels, for detecting voltage and closed/open contact points (for small terminal types and for lines)	High range 250 V rms Low range 150 V rms	250 V rms (CAT II)
	Model 9327 Logic Probe	Four channels, for detecting voltage and closed/open contact points (high-speed type)	-	-
AC/DC Model CT955X or 9318+CT9901 are required for connection.	Model 9709-05 AC/DC Current Sensor	500 A, DC to 100 kHz	-	-
	Model CT6841-05 AC/DC Current Probe	20 A, DC to 1 MHz	-	-
	Model CT6843-05 AC/DC Current Probe	200 A, DC to 500 kHz	-	-
	Model CT6844-05 AC/DC Current Probe	500 A, DC to 200 kHz	-	-
	Model CT6845-05 AC/DC Current Probe	500 A, DC to 100 kHz	-	-
	Model CT6846-05 AC/DC Current Probe	1000 A, DC to 20 kHz	-	-
	Model CT6862-05 AC/DC Current Sensor	50 A, DC to 1 MHz	-	-
	Model CT6863-05 AC/DC Current Sensor	200 A, DC to 500 kHz	-	-
Dedicated for AC Model CT955X or 9318+CT9901 are required for connection.	Model 9272-05 Clamp On Sensor	20 A / 200 A, 1 Hz to 100 kHz	-	-

Application	Model	Description	Maximum input voltage	Maximum rated voltage to earth
Dedicated for AC	Model 9018-50 Clamp On Probe	10 A to 500 A, 40 Hz to 3 kHz	-	-
	Model 9132-50 Clamp On Probe	20 A to 1000 A, 40 Hz to 1 kHz	-	-
Leakage current	Model 9657-10 Clamp On Leak Sensor	10 A AC (Leakage current, 50 Hz/60 Hz)	-	-
Voltage generation	Model L9795-01 Connection Cable	Alligator clip	±30 V	30 V rms AC, 42.4 V peak AC or 60 V DC
	Model L9795-02 Connection Cable	BNC output		
Others For connecting to a module for voltage measurement	Model CT9555, CT9556, and CT9557 Sensor Unit	For Model 9272-05, 9709-05, CT6841-05, CT6843-05, CT6844-05, CT6845-05, CT6846-05, CT6862-05, CT6863-05, CT6875, CT6876, CT6877	-	-
For connecting to the Model 8971 Current Unit	Model 9318 Conversion Cable	For Model 9272-10, 9709, CT6841, CT6843, CT6844, CT6845, CT6846, CT6862, CT6863, CT6865	-	-
	Model 9318 Conversion Cable + Model CT9901 Conversion Cable (both required)	For Model 9272-05, 9709-05, CT6841-05, CT6843-05, CT6844-05, CT6845-05, CT6846-05, CT6862-05, CT6863-05 CT6875, CT6876	-	-

For more information on the output rate of a clamp sensor, see the indication on each clamp sensor or the instruction manual.

Printer

Printer unit	Model U8350 Printer Unit	Specify when ordering
Recording paper	Model 9231 Recording Paper	A4 width × 30 m, one set of 6 rolls

Storage media

SSD unit	Model U8330 SSD Unit	Built-in SSD drive (specify when ordering)
CF card	Model 9728 PC Card 512M	512MB, with adapter
	Model 9729 PC Card 1G	1GB, with adapter
	Model 9830 PC Card 2G	2GB, with adapter
USB memory stick	Model Z4006 USB Drive	16GB

Software

Application software	Model 9333 LAN Communicator
	Model 9335 Wave Processor

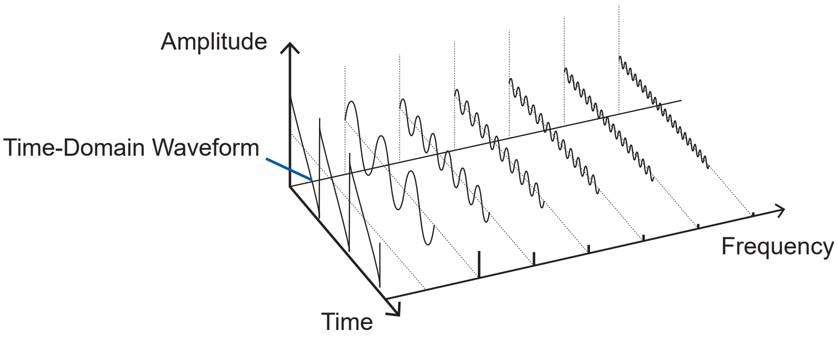
Appx. 4 FFT Definitions

■ What Is FFT?

FFT is the abbreviation for Fast Fourier Transform, an efficient method to calculate the DFT (Discrete Fourier Transform) from a time-domain waveform. The reverse process of transforming frequency data obtained by the FFT back into its original time-domain waveform is called the IFFT (Inverse FFT). The FFT functions perform various types of analysis using FFT and IFFT.

■ Time and Frequency Domain Considerations

All signals are input to the instrument as a function of the time domain. This function can be considered as a combination of sine waves at various frequencies, such as in the following diagram. The characteristics of a signal that may be difficult to analyze when viewed only as a waveform in the time domain can be easier to understand by transforming it into a spectrum (the frequency domain).



■ Discrete Fourier Transforms and Inverse FFT

For a discrete signal *x(n)*, the DFT is *X(k)* and the number of Analysis points is *N*, which are related as follows:

$$X(k) = DFT\{x(n)\} = \sum_{n=0}^{N-1} X(n) W_N^{kn} \quad \text{.......} \quad (1)$$

$$x(n) = IDFT\{X(k)\} = \frac{1}{N}\sum_{n=0}^{N-1} X(k) W_N^{-kn} \quad \text{.......} \quad (2)$$

$$W_N = \exp\left(-j\frac{2\pi}{N}\right) \quad \text{.......} \quad (3)$$

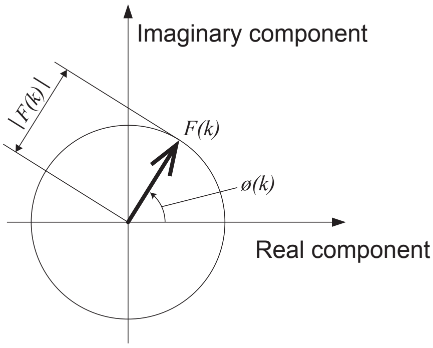
X(k) is typically a complex number, so expression (1) can be transformed again and written as follows:

$$F(k) = |F(k)|\exp\{j\phi(k)\} = |F(k)|\angle\phi(k) \quad \text{.......} \quad (4)$$

$$\phi(k) = \tan^{-1}\frac{\mathrm{Im}\{X(k)\}}{\mathrm{Re}\{X(k)\}} \quad \text{.......} \quad (5)$$

$|F(k)|$: Amplitude spectrum, $\phi(k)$: Phase spectrum

Representing the above relationship on a complex flat surface produces the following figure.



■ Linear Time-Invariant Systems

Consider a linear time-invariant (LTI) system *y*(*n*) that is a response to discrete time-domain signal *x*(*n*).

In such an LTI system, the following expression applies to any integer *Ai* when the response to *xi*(*n*) is $y_i(n) = L[x_i(n)]$.

$$L[A_1x_1(n) + A_2x_2(n)] = A_1y_1(n) + A_2y_2(n) \quad \text{(6)}$$

If the system function of an LTI system is *h*(*n*), the input/output relationship can be obtained by the next expression.

$$y(n) = \sum_{m=0}^{\infty} h(n)x(n-m) = \sum_{m=-\infty}^{\infty} h(n-m)x(m) \quad \text{(7)}$$

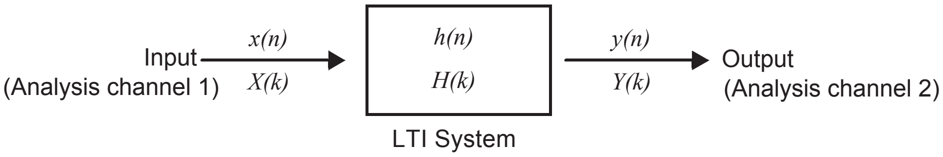
Therefore, when a unit impulse $\delta(n)$ (which is 1 when *n* = 0, and 0 when *n* ≠ 0) is applied to *x*(*n*), the input/output relationship is:

$$y(n) = h(n) \quad \text{(8)}$$

This means that when the input signal is given as a unit impulse, the output is the LTI system characteristic itself. The response waveform of a system to a unit impulse is called the **impulse response**.
On the other hand, when the discrete Fourier transforms of *x*(*n*), *y*(*n*) and *h*(*n*) are *X*(*k*), *Y*(*k*) and *H*(*k*), respectively, expression (7) gives the following:

$$Y(k) = X(k)H(k) \quad \text{(9)}$$

H(*k*) is also called the transfer function, calculated from *X*(*k*) and *Y*(*k*). Also, the inverse discrete Fourier transform function of *H*(*k*) is the unit impulse response *h*(*n*) of the LTI system.
The impulse response and transfer function of this instrument are calculated using the relationships of expression (9).



■ Number of Analysis Points

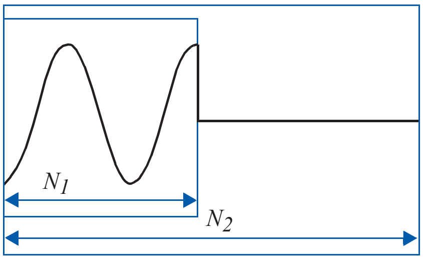
The FFT functions of this instrument can perform frequency analysis of time-domain waveforms consisting of 1000, 2000, 5000, or 10,000 points. However, when the following conditions are satisfied, previously analyzed data can be reanalyzed with a different number of analysis points.

A. When measurements are made with the averaging function disabled (Off)
B. When measurements are made with the averaging function enabled for time-domain averaging (simple or exponential).

When the number of analysis points at measurement time is N_1 and the number of analysis points is changed to N_2 after measurement, the instrument performs as follows.

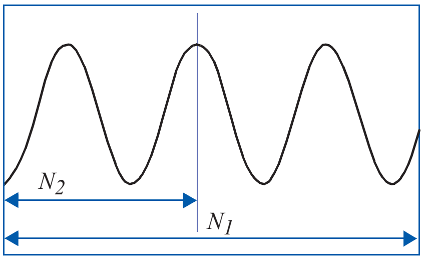
(1) When $N_1 < N_2$

- Because not enough data has been collected, zero is inserted for time after the end of the measured waveform.
- The window function applies only to the N_1 segment.
- Frequency resolution is increased. For example, if N_1= 1000 and N_2 = 2000, frequency resolution is doubled.
- The average energy of the time-domain waveform is reduced, so the amplitude of the linear spectrum is also reduced.



(2) When $N_1 > N_2$

- The specified (N_2) segment is extracted from the head of the (N_1) data.
- The window function applies only to the N_2 segment.
- Frequency resolution is decreased. For example, if N_1 = 2000 and N_2 = 1000, frequency resolution is halved.
- The average energy of the time-domain waveform is unchanged, so the amplitude of the linear spectrum is not significantly affected.



■ Aliasing

When the frequency of a signal to be measured is higher than the sampling rate, the observed frequency is lower than that of the actual signal, with certain frequency limitations. This phenomena occurs when sampling occurs at a lower frequency than that defined by the Nyquist-Shannon sampling theorem, and is called **aliasing**.
If the highest frequency component of the input signal is f_{max} and the sampling frequency is f_s, the following expression must be satisfied:

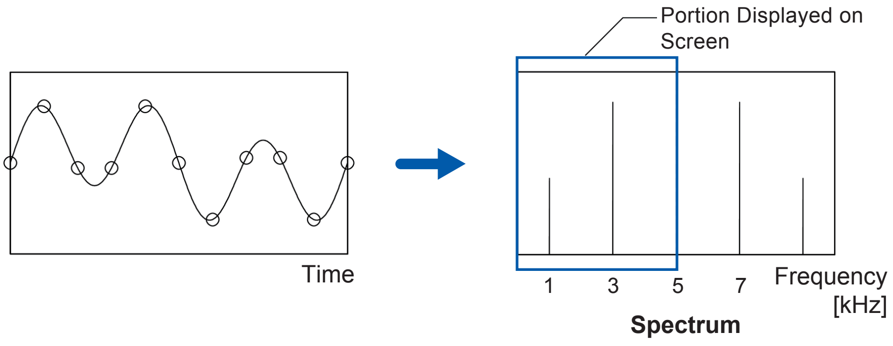
$$f_s = 2f_{max} \cdots\cdots\cdots\cdots\cdots\cdots (10)$$

Therefore, if the input includes a frequency component higher than $f_s/2$, it is observed as a lower frequency (alias) that does not really exist.

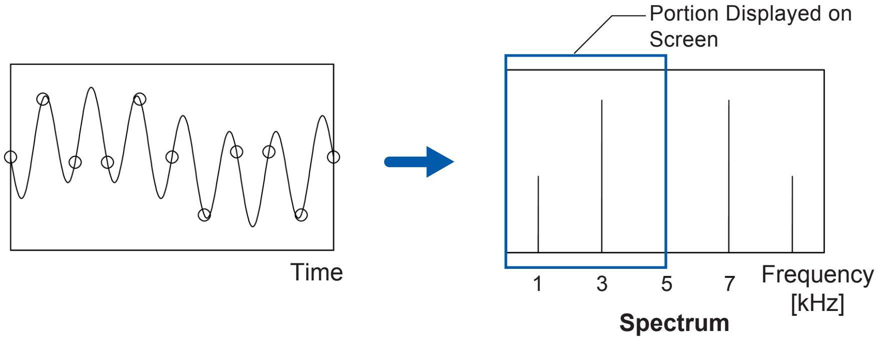
The following diagrams show the results of spectrum analysis of composite waveforms having components of 1 kHz and 3 kHz, and of 1 kHz and 7 kHz.
If sampling frequency fs is 10 kHz, the spectral component of an input frequency above 5 kHz (in this case, 7 kHz) is observed as an alias at 5 kHz or below.

In this example the difference between the 3 and 7 kHz components is indiscernible.

Composite waveform of 1 kHz and 3 kHz components sampled at 10 kHz



Composite waveform of 1 kHz and 7 kHz components sampled at 10 kHz

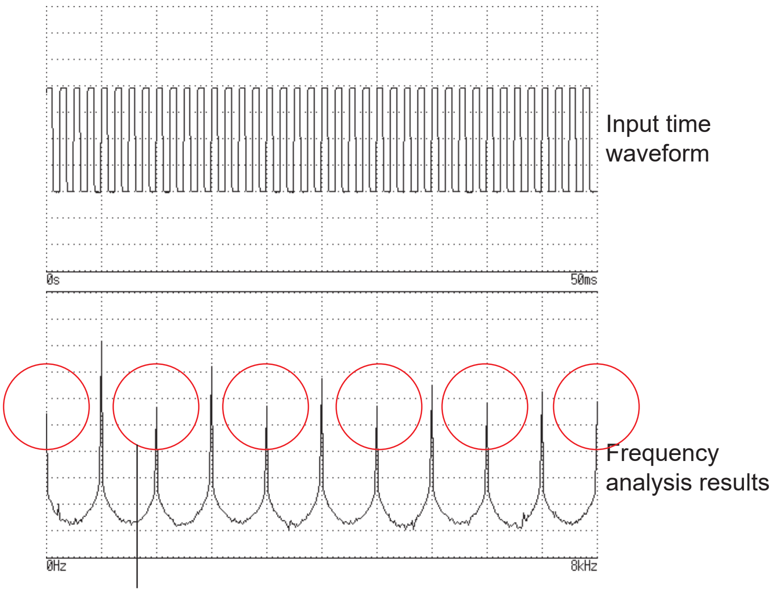


■ Anti-Aliasing Filters

When the maximum frequency component of the input signal is higher than one-half of the sampling frequency, aliasing distortion occurs. To eliminate aliasing distortion, a low-pass filter can be used that cuts frequencies higher than one-half of the sampling frequency. Low-pass filters used this way are called **anti-aliasing filters**.

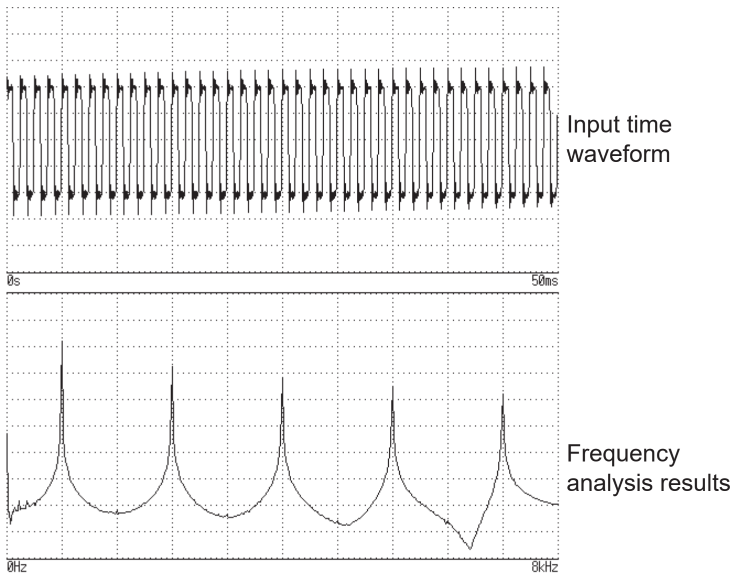
The following figures show the effect of application of an anti-aliasing filter on a square wave input waveform.

Without an anti-aliasing filter



Non-existent frequency components are observed

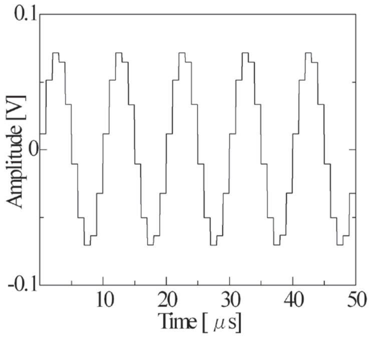
With an anti-aliasing filter



Imaging

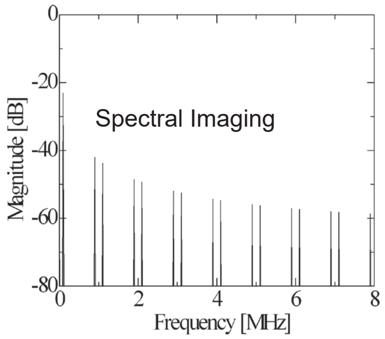
When the instrument is set to a measurement frequency range that requires a higher sampling rate than the maximum capability of the module, intermediate data points are interpolated between successive data samples. In this case, the time-domain waveform exhibits a stair-step shape. When FFT analysis is performed in this situation, non-existent high frequency spectral components appear. This phenomena is called zero-order hold characteristic **imaging**.

The following figures show the time-domain waveform and spectrum of a sine wave applied to the Model 8968 High Resolution Unit.



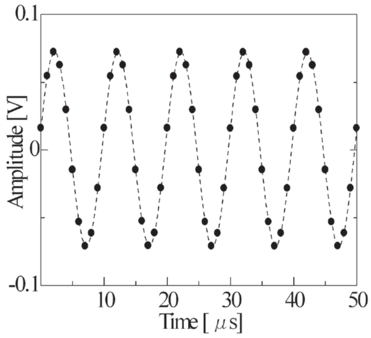
Time-domain waveform in the 8 MHz frequency range (sampling frequency = 20 MHz)

The highest sampling frequency of the Model 8968 is 1 MHz, so the same input data value is used for each block of 20 samples, resulting in a stair-step waveform.



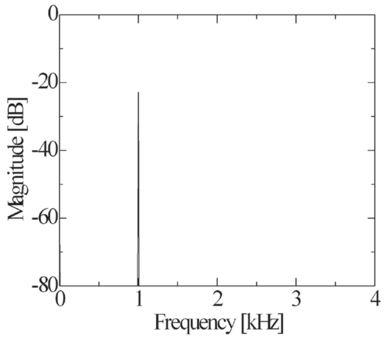
Spectrum

When FFT processing is performed on a stair-step waveform, the resulting spectrum shows non-existent components.
In this case, the spectral components above 1 MHz / 2 = 500 kHz are theoretically meaningless.



Time-domain waveform in the 400 kHz frequency range (sampling frequency = 1 MHz)

Here, the frequency range matches the sampling frequency of the Model 8968 so no interpolation is performed on the time-domain data.



Spectrum

To avoid imaging phenomena when analyzing waveforms with the FFT function, verify the maximum sampling frequency of the module before measuring.

■ Averaging

With the FFT function, averaging is performed according to the following analytical expressions. Averaging in the time domain produces meaningless data if performed with inconsistent trigger criteria.

(1) Simple Averaging (Time and Frequency Domains)

Sequences of acquired data are summed and divided by the number of acquisitions.

$$A_n = \frac{(n-1)A_{n-1} + Z_n}{n} \quad \text{.........} \quad (11)$$

n: count of measurements to average
An: averaging results of n counts
Zn: measurement data of n counts

(2) Exponential Averaging (Time and Frequency Domains)

Before averaging, newer data is given exponentially greater significance than older data.

$$A_n = \frac{(N-1)A_{n-1} + Z_n}{N} \quad \text{.........} \quad (12)$$

N: Specified number of counts to average
n: count of measurements to average
An: averaging results of n counts
Zn: measurement data of n counts

■ Overall Value

The overall value is the sum of the power spectrum at each frequency. This value is nearly equal to the positive sum of the squares of the (RMS) input signals, except when frequency averaging is performed. The FFT function of the instrument calculates and displays the RMS values for stored waveforms and the overall value from the sum of the power spectrum for the frequency domain. Any FFT analysis modes other than the power spectrum, however, take the root square of the overall value to match the unit.

With the FFT analysis mode set to the power spectrum

$$(Over\ all) = \sum_{i=0} P_i \quad \text{.........} \quad (13\text{-}1)$$

With the FFT analysis mode set to the histogram, linear spectrum, RMS spectrum, impulse response, 1/1 octave analysis, or 1/3 octave analysis

$$(Over\ all) = \sqrt{\sum_{i=0} P_i} \quad \text{.........} \quad (13\text{-}2)$$

P_i: power spectrum of value i

■ Total Harmonic Distortion (THD)

Total harmonic distortion (THD) indicates the proportion of the higher harmonics to the fundamental harmonic
This means that the larger the value, the more distorted the waveform.

$$\mathrm{THD} = \sqrt{\frac{\sum (V_n)^2}{(V_0)}} \times 100\ [\%] \quad \text{.........} \quad (14)$$

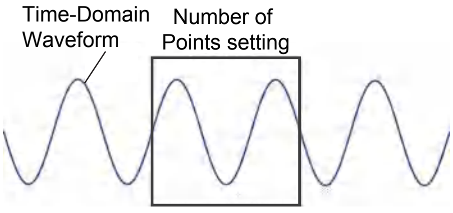
V_0 = fundamental wave
V_n = next higher harmonic

■ Window Function

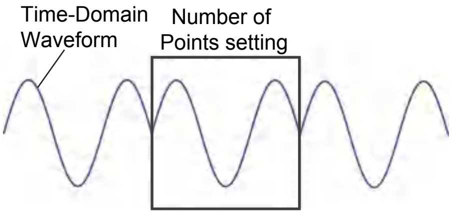
The Fourier transform of a continuous system is defined by the integral Calculus in expression (15) for the time range from minus infinity to plus infinity.

$$X(f) = \int_{-\infty}^{\infty} x(t)\,\varepsilon^{-2\pi ft}dt \quad \text{.........} \quad (15)$$

However, because expression (15) cannot be calculated with actual measurements, the Analysis is performed on a segment between finite limits. Processing the waveform segment within these limits is called **window processing**. For FFT analysis, the waveform segment within these limits is assumed to repeat periodically (as shown below).



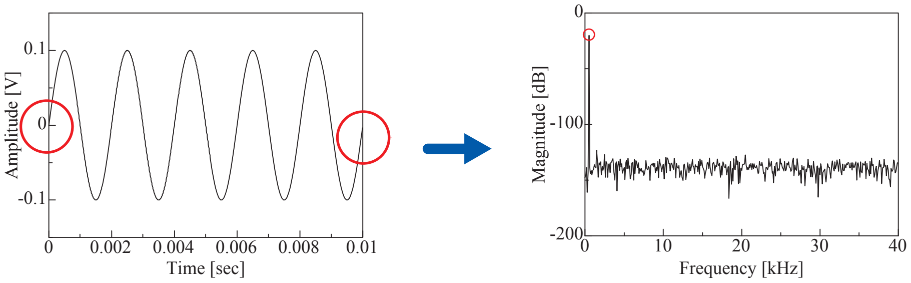
Original Time-Domain Waveform



Waveform to be assumed with FFT

When the number of points for FFT analysis is an integer multiple of the input signal frequency, a single-line spectrum is obtained. However, if it is not an integer multiple of the frequency (When the waveform assumed with FFT includes discontinuous points), the spectrum is scattered, and a line spectrum cannot be obtained. This phenomenon is called leakage error (as shown below).

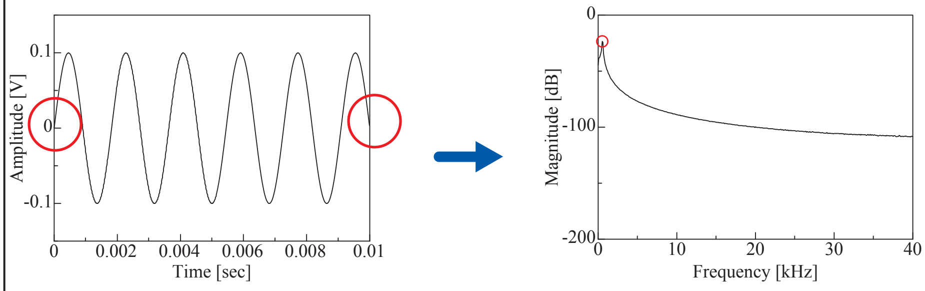
Time-domain waveform when the number of analysis points is an integer multiple of the input frequency



Time-Domain Waveform

Spectrum

Time-domain waveform when the number of analysis points is not an integer multiple of the input frequency



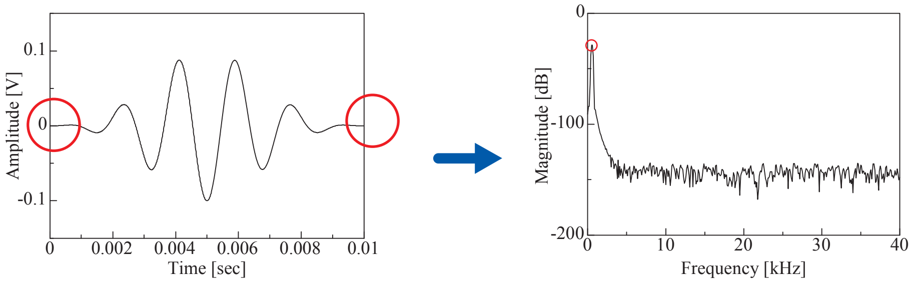
Time-Domain Waveform

Spectrum

The window function was created to suppress such leakage errors. The window function smoothly connects each end of the time-domain waveform where it is cut off.

The following figure presents an example of spectral analysis by applying a window function to a time-domain waveform.
Using the window function, discontinuous points on the time-domain waveform are eliminated, so the wave shape approaches a line spectrum.

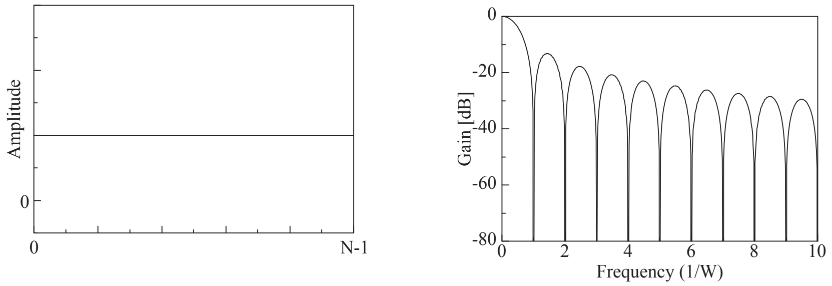
When a Blackman-Harris window function is applied to a time-domain waveform (p. A18) in which the number of analysis points is not an integer multiple of the input frequency



Time-Domain Waveform **Spectrum**

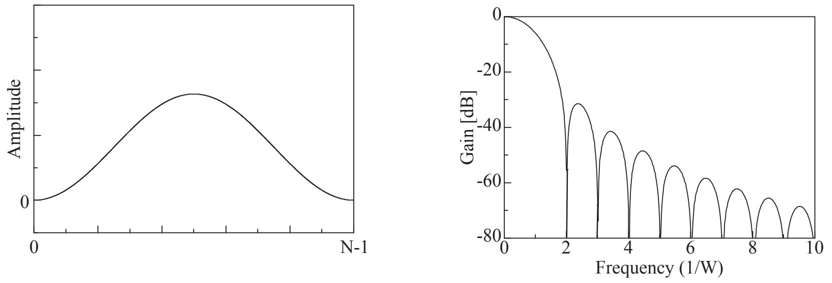
The following figure shows the time-domain waveform of the window function and its spectrum.
Each spectrum shows a large peak at a low frequency, and many smaller peaks at higher frequencies. The largest peak is called the **main lobe**, and the smaller peaks are the **side lobes**.
The most accurate results of the FFT function are obtained when the width of the main lobe and the amplitude of the side lobes are minimized, although both conditions cannot be satisfied at the same time.
Therefore, a window function with a wide main lobe is used when amplitude values are important, while a window function with a small main lobe is used to observe fine spectral details, and a window function with small side lobe amplitudes is used to exclude the effects of the surrounding spectrum.
However, the main lobe width is proportional to the width (1/W) of the window so increasing the number of analysis points increases the frequency resolution.

Rectangular window



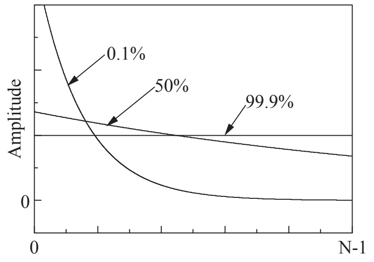
Time-Domain Waveform **Spectrum**

Hann window

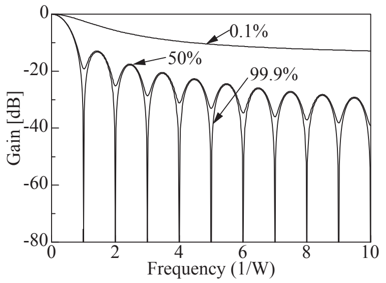


Time-Domain Waveform **Spectrum**

Exponential window

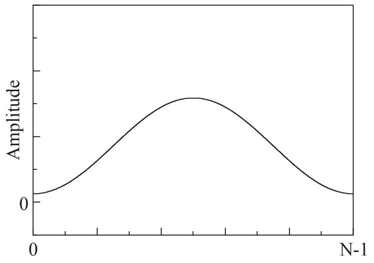


Time-Domain Waveform

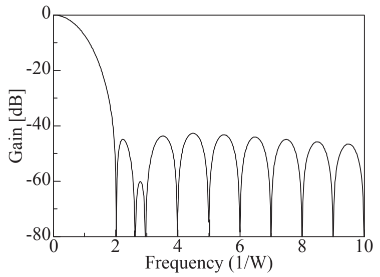


Spectrum

Hamming window

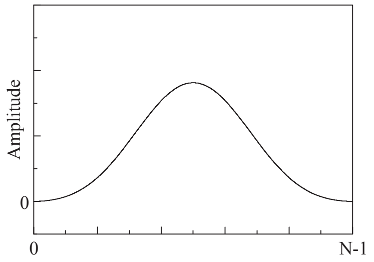


Time-Domain Waveform

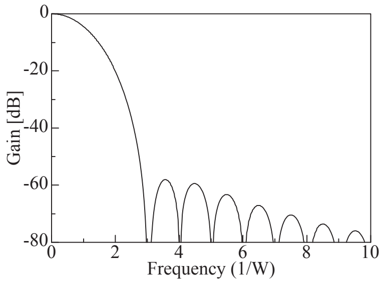


Spectrum

Blackman window

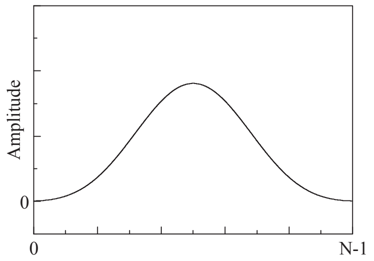


Time-Domain Waveform

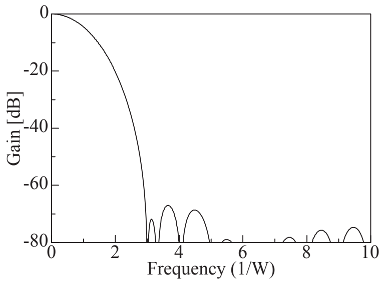


Spectrum

Blackman-Harris window

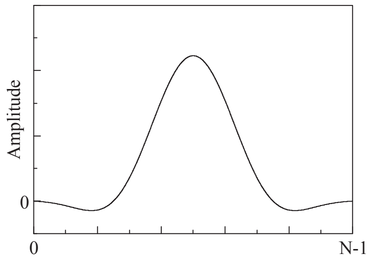


Time-Domain Waveform

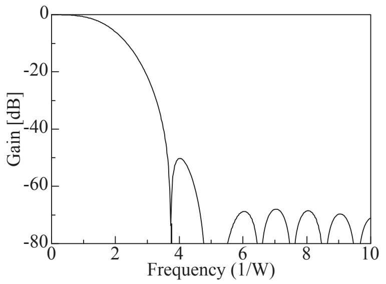


Spectrum

Flat top window

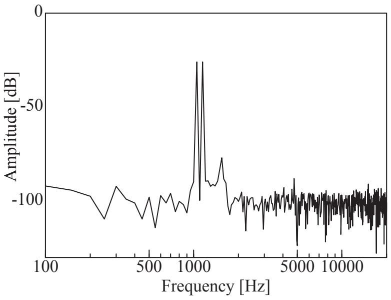


Time-Domain Waveform

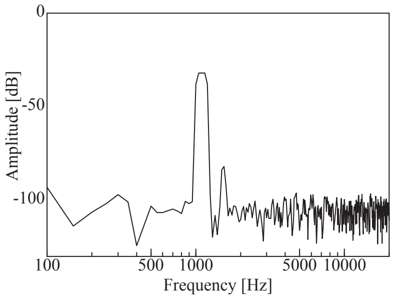


Spectrum

The following example shows input sine waves of 1050 and 1150 Hz analyzed with different window functions.
Because the frequencies in this example are close to one another, a rectangular window with a narrow main lobe is able to separate and display both frequencies, but a Hann window with a wide main lobe displays the two as a single spectral component.



Analysis Using a Rectangular Window

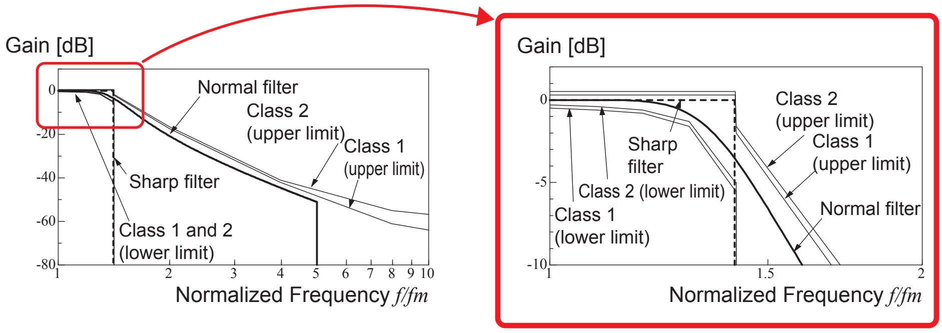


Analysis Using a Hann Window

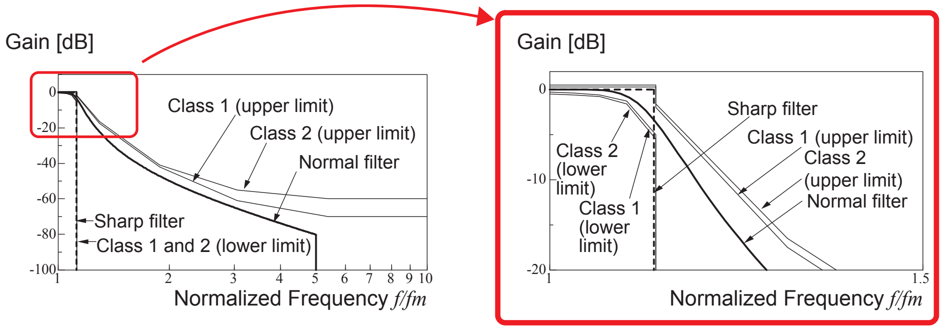
■ Octave Filter Characteristics

Octave filter characteristics are determined according to the IEC61260 standard.
The figures below show these standards and the filter characteristics of this instrument.

1/1 Octave Filter Characteristic

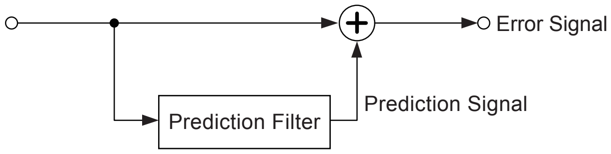


1/3 Octave Filter Characteristic



■ Linear Predictive Coding (LPC)

In the following figure, linear predictive coding is implemented by passing a sample of the input signal through the prediction filter while altering the filter so as to minimize errors in the original signal.



Given a time-discrete signal $\{x_t\}$ (t is an integer) where the input signal is sampled at interval ΔT, LPC analysis presumes the following relationship between current sample value x_t and the value of previous sample p.

$$x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \cdots + \alpha_p x_{t-p} = \varepsilon_t \text{.. (16)}$$

However, $\{\varepsilon_t\}$ is an uncorrelated random variable with average value 0 and the dispersion σ^2.
Expression (16) shows how current sample value x_t can be “linearly predicted” from previous sample values.
If the predicted value of x_t is actually $\overset{\wedge}{x_t}$, expression (16) can be transformed as follows.

$$x_t = \overset{\wedge}{x_t} + \varepsilon_t = \sum_{i=1}^{P} \alpha_1 x_{t-i} + \varepsilon_t \text{ .... (17)}$$

Here, αi is called the **linear predictor coefficient.**
For LPC analysis, this coefficient is calculated using the Levinson-Durbin algorithm, and a spectrum is obtained. In this instrument, the order of the coefficient can be set from 2 to 64. Larger orders reveal fine spectral components, while small orders reveal the overall spectrum shape.

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Warranty Certificate

Model	Serial number	Warranty period Three (3) years from date of purchase (___ / ___)

Customer name: ______________________________

Customer address: ______________________________

Important

- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.
Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

1. The product is guaranteed to operate properly during the warranty period (three [3] years from the date of purchase). If the date of purchase is unknown, the warranty period is defined as three (3) years from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warrantied for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
   - -1. Malfunctions or damage of consumables, parts with a defined service life, etc.
   - -2. Malfunctions or damage of connectors, cables, etc.
   - -3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
   - -4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
   - -5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
   - -6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
   - -7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
   - -8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   - -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   - -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   - -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   - -2. Damage arising from measurement results provided by the product
   - -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

HIOKI E.E. CORPORATION
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18-07 EN-3

HIOKI

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